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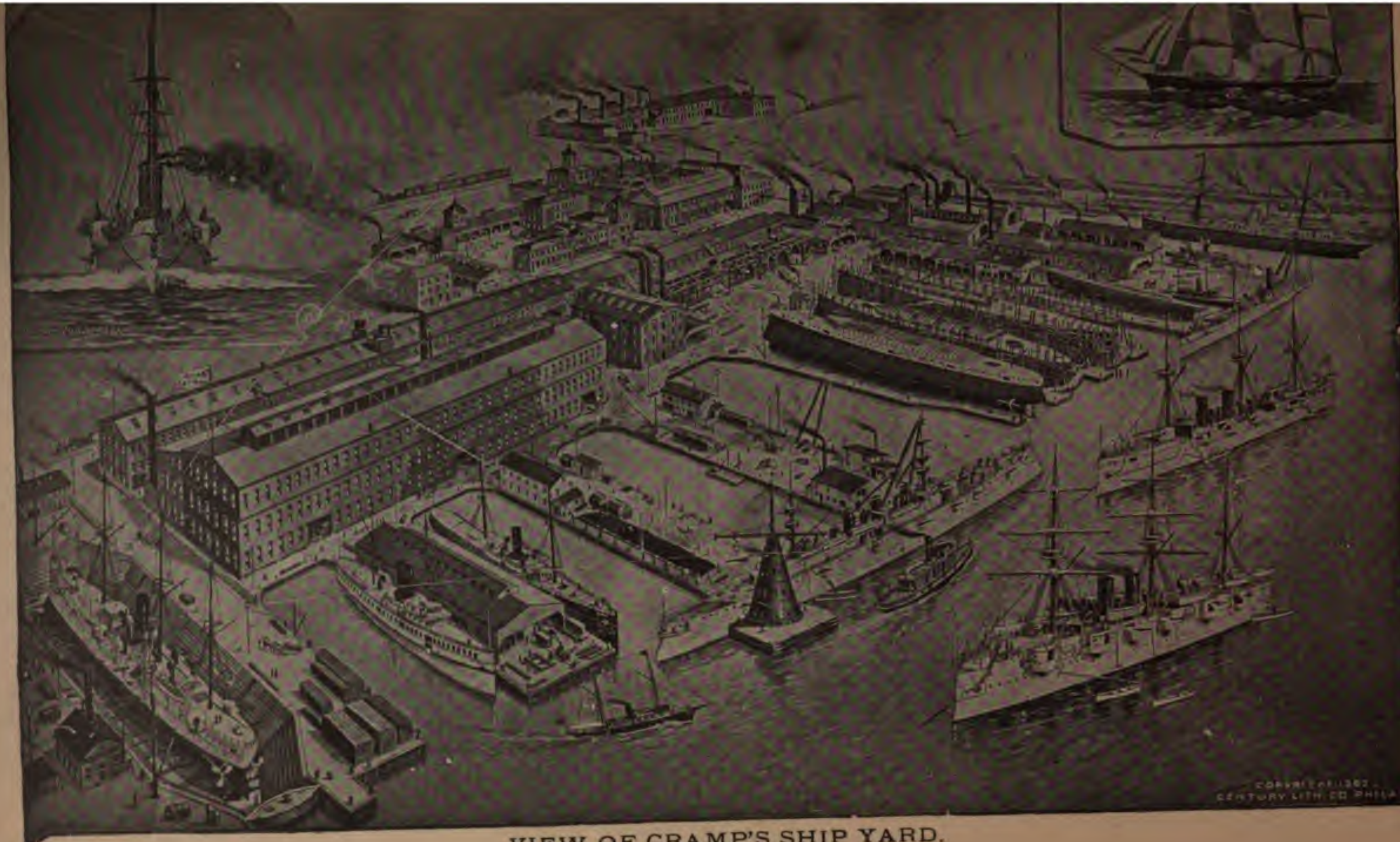

VIEW OF CRAMP'S SHIP YARD.

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THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. XXIX., No. 1. March, 1903. Whole No. 105.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION.

A NAVAL TRAINING POLICY AND SYSTEM.

MOTTO: "*Nunc Aut Nunquam.*"

By LIEUTENANT JAMES H. REID, U. S. Navy.

A number of most interesting articles on the training of men have appeared from time to time in the PROCEEDINGS OF THE NAVAL INSTITUTE; but, not nearly so many have been written as this vital question, the real issue before the service to-day, demands. Meanwhile much time has been wasted without definite result, and the day when action becomes imperative has now arrived.

As stated by Lieutenant Beach in his article, we have to-day scientific corps and bureaus designing, building, and arming our ships and a world-renowned school preparing the officers; while the men are lacking in number, and, part of them at least, in training.

Much has been done and much thought expended in training special classes of men, but the enlisting and training of the mass of an expanding personnel, the raw recruits, has not received the attention it deserves from those most interested, the officers of the service.

In the article referred to above is clearly stated the great importance of having some definite policy, not something which varies with each station and with every ship and captain.

"The country leaves the training of the men.....entirely to the.......officers, and will provide the means that are said to be necessary." Thus we see where the responsibility rests. The expansion of the navy has but begun. The recent history of our rapidly growing country, coupled with the victories of the late war, point to a still greater future for the service. This only makes it more necessary that something be done at once to maintain the enlisted personnel, both in numbers and in efficiency at the high standard they have set for themselves in the past.

Of late great difficulty has been experienced in enlisting qualified seamen, and an extensive training system has been found necessary as older countries have found before, but there are great differences of opinion among officers as to the proper training methods, and most officers avoid the training service as they would the plague,—by some it has been classed as a black-list. It is to be hoped that the future will show a change in this respect.

Our present training system is a growth of necessity and not an organized establishment; and, while the word "system" has been used to denote our present methods of training recruits, nothing is further from the mark in appropriateness. The navy as a whole has no policy and possesses no general and uniform "system of training" for its recruits, nor indeed for much of its personnel in general.

We should, while there is yet time, formulate a policy and establish a general and uniform system, a homogeneous one for the whole navy, certain in results, and insuring that proper training which every recruit should receive. The navy needs the best material possible,—none other is good enough.

The best man for the service is a thoroughly trained one, trained from the beginning up according to a regular progressive system. None can have too much training, none should be admitted to the general service without a certain definite amount of it.

Upon this subject there seems little really original left to be said, and most of the matter is an old story, yet it is neces-

sary to repeat much of it in order to develop the conclusions properly and to outline a policy.

The education of an enlisted man of the seaman branch may be divided into three periods as follows:

1st. Preliminary Training of Recruits,—

To be carried on by a Training Service of some sort.

2nd. Subsequent Training of each Recruit until he is a qualified seaman,—

To be carried on aboard the regular cruising vessels.

3rd. Special Training to make Marksmen, Petty Officers, Electricians, etc.—

To be carried on both on board ship and at Schools of Instruction.

Drilling of all hands to make the ship an efficient fighting machine as a whole is a separate subject, the training mentioned above is individual.

It is the preliminary training for recruits with which this paper chiefly deals, but it is necessary also to consider briefly the subsequent training in order to define a progressive, uniform system.

The scheme proposed herein has been devised from an actual experience of four years' continuous service at the Newport Station and on a sailing training ship.

Having fought the battle of detail day in and day out, dealing with all the perplexing minutiae of the school and ship, striving meanwhile with a continuous stream of over 3000 irresponsible youngsters, considerable opportunity has been had for studying the apprentice and his characteristics. A consequent familiarity with details has been gained, and it is confidently asserted that this plan, the result of notes taken during this time, will be found homogeneous in all its parts, will work with smoothness, efficiency, and economy, and will produce the same number of graduates with as good or better training than the present method; and, as far as the apprentice system is concerned, this plan will use only about one-half the present working force of officers and men. With the same force and increased facilities nearly double the number of graduates could be turned out. Since the above was written the force of officers has been somewhat reduced, but it is believed that this has only been accomplished under the present system at the expense of efficiency.

An inspection of the British training system has given opportunity for comparison and furnished much food for thought.

It is intended in this article to deal mainly with the actual and practical training of recruits, and to outline a complete, uniform, working system.

While similar in some respects to our present apprentice system, it is believed this plan has on the whole very great advantages over our methods of to-day.

For the sake of clearness the subject has been divided into the following heads, which will be considered in the order given:

1. The Need of Our Navy for Trained Recruits.
2. The Question of Sailing Ships and of the Independent Training Ship.
3. Our Present System, its Faults, and Their Remedy.
4. Conclusions.
5. A Proposed Policy.
6. A Scheme for a General Uniform System.
7. The Economics of the Question and of the Unit Station.
8. Subsequent Training.
9. Good Methods and Bad.
10. The Unit Training Station.

(1) The Need of our Navy for Trained Recruits.

In the light of modern progress, where skilled labor is more and more necessary in every field of endeavor, and, where the whirl of competition makes more and more desirable the highest trained intelligence, it seems as if stating a self-evident proposition to say that a thorough training is needed to fill every position in the personnel of a modern, scientific, and complex navy.

Yet while other navies have developed policies and provided not only for training their present force, but for providing a sufficient and increasingly efficient personnel in the future, we have halted between several opinions; and, to-day, despite noble efforts in some directions are surely falling behind in this respect. The "man behind the gun" is a factor of prime importance and his training is not to be lightly considered. It cannot be begun too soon, nor continued too long.

Few persons thought some years ago that war would come when it did; and, none know what the future may have in store. We cannot afford to neglect this needed preparation, and should

therefore settle this question now for all time. The expansion of our navy is but beginning. False and inefficient methods will be fixed upon the service if something be not done. Now is the time to make a good beginning—"*now or never.*"

To-day England will accept no merchant seaman; no matter how good, he is not good enough for their navy; he has not the discipline, the traditions of the service, the *esprit de corps*, which go to make their service so homogeneous and efficient as a whole.

In our present state, we would welcome into our service such material as England rejects. It is believed, however, that we have the best ships; in many ways the most highly trained officers; and a small class of men and petty officers who have not their superior in the world. To this is due our unbroken success in the past, and, we might rest content, were it not for the fact that the class of men who have made this glorious history is dwindling day by day, and there does not exist in this country, a similar class to take their places. These men gained their experience, their handiness and resourcefulness in the hard school of the sea, in the old time sailing ships, and though times and ships have changed, the remnants have accommodated themselves to modern guns and methods.

Years were taken in this old time training and in the past men did not rise to positions of responsibility except with long, hard service. This school of the sea in the full rigged ships, practically exists no longer, the "shellback" in his pristine glory is almost extinct, and many things not to be learned in that school are required of the man-of-war's-man to-day.

It is evident that much more comprehensive training and a higher order of intelligence are needed now. The day when a petty officer could not sign his name is passing,—for some rates it has already passed. Our navy is rapidly filling with men who lack the great sea experience of our fine old sailors, and many of whom lack the training, which, in part, makes up for this deficiency. Many of them are too old to learn and can never hope to advance. The man-of-war sailor belongs to the class of skilled labor; he cannot be picked up on the street; those we have are too few in number and the vacancies are still on the increase. Young men are ready and willing to step into these vacancies; young men of American birth, with American courage and ideals, with an

educated intelligence and an independence of thought not possessed by the older men, and yet lacking at enlistment in the essentials of a seaman,—knowledge of his many and varied duties and real sailor experience. The latter we may not impart, it can be gained only in time and service; the former however, the training, we can and should give,—thorough, uniform, progressive and continuous. Let every man receive it on enlisting, let none rise without, nor without the stamp of the system, and let none settle down to the decay of stagnation.

Our navy is filling with the youth of America; to-day is becoming more and more the day of the young man. Let it be seen to then, that he has the training which he needs, and that he is fitted in every way in our power to fill the positions awaiting him.

Older nations have seen the writing on the wall, and have gone earnestly to work to train their future men. Therefore it behooves us to make this needed training—not a theory—but a fact. Let us have training, earnest and adequate, training for to-day and for the future, training in all its branches; and above all the best training in the world.

Many excellent orders and regulations tending toward this end exist to-day, but others are needed, and all should be reduced to a system.

With this object in view let us look at the necessities of the situation.

We must start with material that can be molded; therefore, "Youth" must be the corner-stone of our system.

The material must be of such quality as to justify the work expended upon it and to make possible the results desired; therefore, "Intelligence, Physical Fitness, and Moral Character" must be the foundations of any scheme of value.

Upon these must "Training" rear the superstructure which "Experience" will furnish and complete, as the habitation, not of the "Heart of Oak" of the past, but of the "Nerves of Steel" of to-day and of the future.

An apprentice system with a carefully worked out policy, a thorough course of instruction, a weeding out of "undesirables" and with advanced schools for ambitious graduates, alone fulfills these requirements.

As Captain Cooke has well said in his article on "Naval Re-

organization," "the navy should be manned as far as possible by those who have been regularly trained for its service so that all our 'bluejackets' might come from the same source, own the same training, love the same country, and glory in the same traditions."

(2) The Question of Sailing Ships and of the Independent Training Ship.

This burning question has agitated the navy for years; but it is believed that the time has come to lay the ghost,—the real substance died a natural death some ten years ago. For, seriously speaking, time and necessity have settled this question. In reality for some years no recruits have received a seaman's "training in sailing ships" within the actual meaning of the phrase.

Not for one moment is it the purpose of this article to deny the advantages to be gained by acquiring real sailor experience, nor to question the arduous and valuable work carried on by the officers on the sea-going training ships.

Captain Chadwick's able article convinces one of the great value such training has always been to our navy. It is undoubtedly of value to bring "the young sailor man face to face with his great teacher, the Sea." But in the modern high-powered steamer the sea has much less proportional effect; except in the smaller ships only the heaviest winds and seas produce much inconvenience, and even then it is a question much more largely to be dealt with by the officers alone. Consequently it is doubtful whether the necessary time that would be taken by the recruits in acquiring this experience could not more economically be utilized in other ways.

The questions of danger in fog, of collision, are ones to be dealt with by the officer alone. The lookout on a steamer needs quicker eyes and sharper ears than his brother of the sailing ship; the leadsman has a harder task; and more responsibility rests on the machinist than on any petty officer of the past.

Captain Goodrich very aptly puts some essentials of a seaman's training, but "the tossing of a rope, the handling of an oar" do not pertain to sailing ships, and the ability to think and act can be trained in other ways. The locomotive engine driver and the city fireman are among the highest types of this ability.

It is not to be disputed that "the navy of to-day, is to-day what it is because of what it has been." It is simply a question of necessity and of economics which confronts us. It is not believed feasible to give our men the same training they have had in the past; it is certain we are not doing it to-day. It remains for us, if we cannot duplicate the men or the training of the past, to decide upon a policy, and to produce a man suited to every modern need, and if possible, as good as, or better than those we have had heretofore.

The seaman of to-day must, as heretofore, shoot straight and often; must handle an oar and steer the ship; must heave the lead and run a line; must be able to rig a purchase and lift great weights; and must handle heavier anchor gear than ever; but these things can be learned on a steamer. Besides these, he must be able to handle hoisting engines, to deal with the great forces of steam, electricity, pneumatics, and hydraulics, and more than ever the service requires quick thought and ready action. The place where these qualities and abilities are needed and used is a good place to acquire them. A certain ground-work of preliminary training, however, is essential to make the recruit fit into his place on board the fighting ship and to relieve the ship of this burden of instruction.

It is not believed that the advocates of the "training in sailing ships," having in view the shortage of officers and men, would seriously advocate two or three years in a sailing ship for each man, with the resultant small number of graduates turned out. The economy of the navy of to-day would not admit of such an expenditure of time, and less time would not produce the results desired.

Now let us see what are the actual conditions of this service at present. We have two sailing ships in commission, that is, ships entirely dependent upon their sails, out of a total of twelve ships in the training service. This certainly does not look as if any fixed system of "training in sailing ships" exists to-day. Five or six other of these ships have sail power with auxiliary steam, but even with these which are not dependent upon their sails for entering and leaving port, or in many cases when a seaman's resourcefulness might be tested to its limit, only about one-half of the recruits are being trained on ships with sails. The mass of the landsmen have been trained on ex-freight steamers.

And on the sailing ships themselves, what is the actual condition? One hundred and fifty or more recruits aboard for from four to six months, one-half of which is spent in port. During the remainder, the actual cruising time, good instructors are too few to give the proper individual instruction; simultaneous drills held on open decks interfere with each other; continued night watches make the recruits sleepy and inattentive; in times of emergency, except the few who would be good anywhere, the raw recruits are of little use, and the men do all the difficult work. Meanwhile the bearing and manner of men, and even of petty officers not properly selected nor trained under the same system, unsettle the ideas acquired at the training station and subvert discipline. The daily contact with the bad and worthless characters among the recruits themselves, who cannot be gotten rid of on a foreign cruise, do great harm in many ways, and the example and advice of the disreputable element among the men hastens the perversion of morals.

It is recognized by all that the development of character is the main object with the youth under training. That the cruising training ship, with its short cruise, is to-day the only, or even the best school for this purpose seems to require considerable additional proof. Two or three years of this sort of cruising in a sailing ship would be splendid. But can we spare the time?

The ship itself is a singularly ill-adapted class-room for instruction in anything save the actual duties of the ship. In time of war it would be better to have all recruits at hand in stations whose systems would not be interrupted, rather than scattered in foreign waters in defenceless vessels. As stated before, each training ship is independent, the training heterogeneous, and the results not uniform.

On the whole, it does not seem, considering the short time that can be allotted to this training, and in view of the large number of officers and men required by the present system, that the independent cruising training ships can produce the necessary uniform results and at the same time turn out a sufficient number of graduates, unless a decided increase be made in the number of recruits carried by each ship, with a corresponding loss of efficiency in instruction. An increase in the number of such ships would also be necessary. This would be an exceedingly expensive method in officers, men, and money.

Besides this, in time of war or other emergency a call for the officers in these ships to man fighting ships would result in the collapse of the training system. A barrack system with auxiliaries directly attached would suffer much less and would still be in full operation with only two officers on duty. On smaller, handier ships with fewer recruits to each part of the ship, opportunities would be greatly increased for recruits to have charge of important work and to be thrown on their own resources, all of which develops character. And with fewer recruits to each petty officer much better instruction could be given.

Do not let us forget that the final object of all training and drilling is to be prepared to deliver a rapid and effective fire in the day of battle. Perfect physical development is necessary to keep brain, body, and nerves in the condition in which this result can be best attained, but this development can be gained in other ways than by work aloft.

Courage is more or less inherent in the English speaking race; education and self-respect compel men to do their duty; if carefully enlisted and well weeded out, we need not fear for the bravery of our men. Neither sail drill nor reefing topsails in a gale can make a brave man out of a coward. Training and service will bring out the latent qualities, good or bad, and selection must do the rest.

The Gloucester fishermen are as fine sailors as ever lived, and handle their dories in weather which makes a man-of-war's boat as useless as a racing shell, yet they have not learned this in the school of the square-rigger and they do little work aloft.

Activity, resourcefulness, bravery, these are the qualities claimed for the old-time sailor, and, it is true, they are in much demand still; but the American has not deteriorated in courage and as for the other qualities, more than these are needed to-day and there may be quicker and more economical methods of acquiring a modicum at least of these with many others thrown in.

Captain (now Rear Admiral) Glass wrote 16 years ago, "The seaman of the future ships must be more than a smart topman, he must also be an artilleryman and a mechanic. . . . . The seamanship of the future will in some respects differ as greatly from that of the past as do the vessels themselves from the old sailing ship."

Let us then do one thing or the other and do it thoroughly,—it seems we cannot give the real sail training; then why keep up these costly ships when smaller auxiliaries will do their work more economically and efficiently?

The arguments presented in Lieutenant Beach's article and the quotations cited there all point to the desirability of some training in sailing vessels, but in a smaller class of vessel with fewer in the crew than at present. As will be shown, the economics of the question lead to the same conclusion. These smaller vessels would properly be attached directly to the training stations, and would be limited in their cruises; but, with fewer men, these auxiliaries would be dependent on the recruits, who must and would rise to the occasion. Those best fitted for the service would thus be more surely sorted out.

The time has come for a decision upon this question. The British have stations with auxiliaries only; we have been drifting that way, and at Newport have almost reached the same point. Let us put an end to the delay. If necessary, have a board called to investigate and report. Let the report be acted upon, and let us bend all our energies towards perfecting the system decided upon, whatever it may be. Any system is better than our present chaotic state.

(3) Our Present System, its Faults, and the Remedy.

As has been stated, we have no uniform "System of Training Recruits." Several valuable and efficient organizations exist, but each is conducted independently, and each station and ship is a law unto itself. This hardly insures to the service the efficient and uniform product that should be the aim of all. In comparison with that of England our system is feeble and disjointed, more expensive, and much less efficient. With a few important changes on the lines indicated it is believed our system would surpass that of any power in the world.

Quoting again from Capt. A. P. Cooke's article, "The enlistment of men......who seek the navy as an asylum of last resort should not be permitted...... Because good men will not enlist, worse are taken, and because of the conduct of these, good men will not stay...... The livery of the United States should be made a badge of character and worth, and the privilege of wearing it considered a great honor...... The gen-

eral public would soon learn to recognize an honorable discharge as a certificate of courage, intelligence, subordination... We should endeavor to elevate the enlisted man, to arouse his self respect........ We must endeavor to attract a higher class of recruits."

Many steps in this direction have been taken, but we are yet far from what should be the goal of our endeavors.

To quote again from an article by Captain Glass, "Years are occupied in building and arming a modern vessel of war, but how much longer time will be required to train the brain, the eye, and the hand of the man who is to manage the complicated machinery with which modern invention has replaced the armaments of a quarter of a century ago? No time then should be lost by the officers of the service in deciding upon what is necessary and in formulating plans that will meet the needs of the present and the future."

As pointed out above there should be but one source of supply for the seaman branch of the service and a uniform system somewhat similar to our present apprentice system is urgently needed. No better men exist than the petty officers and warrant officers who have risen from the bottom wearing proudly and with honor to the service the "figure of eight" upon their blue shirts.

We have to-day too many classes of men, working under different regulations, with different rates of pay and different privileges and rewards. They compare their conditions among themselves and one or all become dissatisfied. Do away with these distinctions, make all alike, and reward all sufficiently and there will be less dislike of the service. Give more liberty, remove many petty annoyances, equalize and systematize reports and punishments while still allowing commanding officers enough latitude, and there will be more contentment. One of our worst stumbling blocks is the class of inefficient petty officers, who cannot and do not assume the responsibility and authority rightfully theirs. We are rapidly overcoming this however by excellent schools and regulations.

Our term of enlistment while better than formerly is too short, but it is doubtful whether Americans with their independence and restlessness will enlist for longer terms. However, it is perfectly feasible, as has been suggested, to have a long term

continuous enlistment carrying special pensions and with leave at regular intervals. Three years apart for the leaves in these cases, except where the service would not permit, would be more agreeable to the men, but it should never be more than four years.

This enlistment could be optional without changing any other laws at present, until at some future time when it is firmly rooted and a sufficient number have taken it up to permit of making it compulsory, when continuous service and pension are desired.

"In England," quoting from Lieutenant S. A. Stanton's article, "the training system which keeps boys in the service until the age of 28 or 30 has revolutionized the character of the personnel."

"In America the training system which lets boys go at 21, has appreciably improved but has not radically changed the character of our crews. We have a *training system and an untrained service* and the results are not likely to change while the present system continues." The italics have been added.

The existing condition has been realized by some of our more advanced officers in years gone by and noble efforts made to bring order out of chaos; but, until recently, the results though excellent in quality, have been meagre in quantity.

Twenty years ago the present training system of apprentices was established through the efforts of Rear Admiral S. B. Luce and others, and has struggled along until to-day it is on a firm basis. Another system, the Landsman Training System, exists alongside it, and is much less extended it its training; and, in its present condition can never produce the same results. This system, as well as each of the two apprentice stations and each of the cruising training ships, has a routine of its own, and each have different methods; so that the products are necessarily heterogeneous in antecedents and in training, in traditions and in qualifications. Certainly the best results cannot be obtained by these methods.

The apprentice system consists of two stations, one at Newport, the other at San Francisco, and of four cruising training ships, three on the Atlantic and one on the Pacific. These ships make about two cruises a year on the average, and about 1500 apprentices are sent into the general service yearly.

The apprentices are enlisted at ages from 15 to 18 and rated

apprentices, third class, with $9.00 a month pay. They are retained at the station for from 3 to 9 months (a very irregular time), this variation being largely due in the past to the fact that when a ship arrived at a station, she had to be filled up, no matter whether there were enough apprentices at the station qualified for transfer or not. Many have been transferred at 2½ months, others at 14 months. This is especially bad for the service; the short time ones are always handicapped for the beginning at least of their cruise, and the others, kept without cause after they naturally expect to go to sea, become dissatisfied, and discipline at the station suffers in consequence. A rigid rule in this respect varying only for exceptionally bright or for very stupid boys is a necessity.

After a cruise of four to eight months these boys are examined and, if passed, are sent into the general service as apprentices, second class, at about 17 years of age with $15.00 a month pay. At the end of a year they may, if qualified, be rated apprentices, first class, at eighteen years of age and with $21.00 a month pay, and then serve until 21 years of age. After reaching the grade of apprentice, first class, they may be rated as petty officers and receive the pay of their rate. Many of the best petty officers in the service to-day are ex-apprentices. Almost all of the younger warrant officers come from this class.

The other system, the Landsman Training System, takes young men of ages from 18 to 25 years, and places them upon training ships only three of which have real sail power; one is a gunboat; the others being converted freight steamers. The latter carry by far the greater part. The cruise lasts from six to eight months and then these landsmen, at the age of about 22 years, are sent into the service as ordinary seamen, with pay of $19.00 a month.

Stations at Norfolk and at Port Royal, S. C., have been partly developed for this service, but the one at Port Royal has unfortunately had to be abandoned and the other is yet in its infancy and is lacking in equipment for such a large body of men. Another station is being established at New London.

These ordinary seamen may, as far as the regulations go, be rated seamen almost as soon as they are received on board the regular ships, and then receive $24.00 a month. They may then be rated petty officers at any time. Their too rapid advancement is bad for the service and unfair to the apprentices.

There are far too few properly qualified petty officers in both these services to give proper instruction.

Every man in the seaman branch on every one of our ships should be able to get the rate of seaman and all should be working towards that end. By the end of the first regular cruise every one of these ought to be qualified and rated "seaman." No man ought ever to be kept below the rate of seaman because there is no number vacant. Careful safeguards of examination, etc., must prevent the advancement of incompetent men; but this individual training should be carried on in every ship as entirely distinct from "drilling" which is for the purpose of making the ship an efficient fighting machine as a whole and has little to do with individual education.

This training should be for all those not qualified for "seaman;" and all men and apprentices over 18 years of age, the age of legal enlistment, should be on the same footing. Since his parents give up the control of the apprentice at the start, the crisis of 21 has really little to do with the question,—18 is regarded as the age at which a landsman becomes responsible and he is then treated as a man; there is no good reason why an apprentice should not also be so treated. His enlistment then should be for four years from the time he becomes 18. It would be better of course if this term could be made longer and a more real return made to the government for the time and money spent in training, but this it is feared is impracticable—a gain of one year by the method proposed is of great value and by other means re-enlistments may be increased. The service must be made their life profession.

Let us have three grades of seamen,—Seaman, Seaman second class, Seaman third class, dropping the useless titles of Landsman and Ordinary Seaman; have no one in general service who has not had some training; train all until all become "seamen" or are discharged. The seamen of ability and petty officers who have not had the opportunity can then be sent to technical schools and petty officer schools, but none except men of and above the rate of "seaman" should be so sent.

By some such means the title "Seaman" may be raised to the proud position it should occupy.

Seamen and petty officers of good conduct should have practically unlimited liberty, the men under training less, but more than to-day.

Every effort must be made to make the positions desirable and to instil ambition into the minds of the youths now entering the service.

The whole enlisted force should be homogeneous and we must work toward the increase of the number of apprentices until they make up the whole of the enlisted personnel; for as we have seen "youth" is a prime requisite in our recruits. Then will we retain the products of the training system and the personnel be on the road to perfection.

Now let us consider the necessities of a "training system for recruits."

There can be no doubt that the landsman system as it exists is only a makeshift,—it is only as it acquires shore stations and begins to approach the apprentice system, that it becomes worthy of the name. The only real system is the apprentice system. The enlistment of recruits over 20 years of age is harmful to the service, much better none over 18. The landsmen should be amalgamated with the apprentices and one uniform system established.

The principal faults of the present apprentice system are as follows:

1. Lack of uniformity and cohesion in whole system; can be remedied by a stroke of the pen of the proper authority establishing some such system as outlined.

2. Lack of care in enlisting,—the remedy suggests itself.

3. Too short enlistment for proper return to government for training given. An improvement has been suggested. A continuous enlistment should be tried and at least given a chance.

4. Insufficiently thorough and early weeding out of manifestly poor material. Regulations covering this can easily be made, though the present ones seem explicit enough.

5. Lack of a sufficient number of qualified petty officers as instructors. The Petty Officer Schools are improving these conditions. Regulations should prohibit any one not qualified from instructing recruits, and these with the additional pay for the Certificates as Instructors as already allowed will suffice.

6. Tremendous drop from rigid atmosphere of a training station to the freedom of a cruising ship. As the service fills up with trained men this will right itself.

7. Insufficient inducement to retain the graduates. Many

valuable regulations to this end have been made recently and some others thought desirable are suggested herein.

With improvements on the above lines and a multiplication of the present stations, sufficient trained recruits of an exceptionally high class can easily be provided.

That the early training of the raw recruit before going aboard a training vessel can be best and most efficiently carried out in barracks seems no longer to be disputed.

With such material, barracks are unquestionably safer and healthier from a sanitary standpoint, better for maintaining discipline, more efficient for instruction, and more elastic for a constantly changing complement with daily enlistments and discharges.

Then, too, there is a permanency attaching to a station with barracks, an accumulation of aids and apparatus, a growth of customs and traditions, a possibility of additions and extensions, and an immunity from unreasoning changes, which is lacking in the floating tenement.

Of the total number of recruits enlisted, a large percentage are found unfit for, or leave, the service; and, to take these to sea, even for a short cruise, where they cannot be gotten rid of and where they occupy valuable space, is an unmixed evil, a great loss in economy, and a waste of the time of officers and instructors.

It seems an undeniable principle that all training stations should have barracks for this preliminary training as well as vessels for perfecting the finished product.

We have made a good beginning in this respect, extension of the system is all that is necessary. The station at Newport especially is an excellent institution and needs only a reasonable amount of aid in the future to become more and more efficient. The ship question, as has been shown, is hanging in the balance; it is not believed that such a heterogeneous outfit, expensive in every way and meagre in results, can continue much longer. Certainly, it is absolutely necessary that all the stations, and the ships which take the output, shall be under one head, responsible for the whole.

The station at Newport turns out a certain number of recruits a year; to complete this training the cruising ships with the same number of recruits require nearly three times the number of

2

officers and men as are employed at the station, not to mention the great expense of their maintenance.

The substitution of several smaller and handier auxiliary sailing vessels and proper auxiliary craft for gunnery training attached to each station, with only sufficient complement to care for them, would solve the economical problem, would return to the general service many officers and men, and would save the great outlay necessary for the maintenance of the independent cruising training ships. Such auxiliary sailing craft would give a much greater field for individual instruction and effort, would permit of more careful training under a uniform system, would promote that resourcefulness, strength, and activity so desirable, and in the end be more efficient for the modern service, even if there were a small loss in deep sea experience.

4. Conclusions.

The following conclusions on which to base a policy and system of training recruits are believed to be justified by the facts set forth herein.

1. The navy needs, for those who in future will man and fire her guns, the best obtainable; the standard of enlistments should be high, and the undesirable element which gets in should be relentlessly weeded out. We cannot enlist trained men, therefore we must train those we do enlist.

2. The thorough training of all recruits is a necessity. All must start young and all must have a chance to rise to the top.

3. Uniform training under one system is the only logical and efficient method. There may be age classes under same system. Training must be progressive throughout whole time in service.

4. Such a system should have only one head with responsibility for and authority over all parts of it.

5. The training must, at least in the beginning, be as individual as possible.

6. Recruits should be completely under control of a district station until graduation. Such a typical station with all its appurtenances has in this article been designated a "Unit Station."

7. Expulsion of undesirable material at any time should be

compulsory and unlimited. Raising of standard best way to get good material. Longer enlistments desirable.

8. Impossible to teach all a seaman should know in one year; discipline and a few important subjects should be thoroughly taught.

9. Individual training cannot be carried on by officers directly (not enough officers if for no other reason). The logical result—the petty officer is the proper instructor.

10. None but properly qualified instructors, of good conduct, should be permitted to instruct recruits. Training of petty officers for such duty a necessity. Work is responsible and wearing,—there should be corresponding compensations.

11. Early training of recruits can best be carried on in barracks on shore.

12. A certain amount of training with sails is still considered a necessity, but experience in regular service and in boats must be the great teacher of the ways of the sea.

13. Cruising sailing ships for training too expensive in officers and men. Not possible under present conditions to allow time necessary for real sailor training in these ships as in the past. Other *independent* training ships no reason for existence.

14. Auxiliary vessels attached to each station, then the logical conclusion. More economical, and with fewer recruits per instructor, more efficient for instruction. Much better to keep recruits in touch with station until properly weeded out.

15. These vessels must always be in touch with their station, and able to transfer at once any recruit found unfitted for the service.

16. The working in and out of port required of these auxiliaries necessitates a smaller, handier type of vessel than those heretofore in use in this service.

17. These auxiliaries give a great opportunity to train young officers to command, and do it with economy to the service.

18. Every moment of the course must be utilized to accomplish necessary results. This can be realized only at a properly constituted station with a properly constructed barracks. The loss of time in moving about a poorly designed one is enormous, not to mention the loss of discipline due to increased difficulty in handling and controlling so many raw recruits, and the danger to health in unsanitary quarters. The barracks at

Newport are hard to heat, damp and exposed in situation, and to-day sickness is rife there.

19. A fixed time for graduation of recruits qualified is a necessity. Until then they should be kept separate from other men. Quality not quantity must be the aim of stations and ships.

20. There should be rigidly insisted upon qualifications for advance to any rate throughout the service. Every man should have a chance to reach seaman grade when qualified and all should be required to qualify before advancement to any other rate in this branch.

21. Every effort must be made to produce efficient petty officers and instructors, and to raise their status in the service. A continuous service enlistment should be required of petty officers above third class after a certain date.

22. Other changes in the Navy Regulations should be made to equalize rates and pays, and do away with much needless discontent. Have more uniform system of naming rates, thus: Seaman; Seaman, 2d class; Seaman, 3d class; Seaman Apprentice, and Apprentice, 1st and 2d class. Change name "Petty Officer" to "Rated Officer" or "Sub-Officer."

5. A Proposed Policy.

The purpose of this paper is to deal with the training of recruits, and it is not the intention to enter deeply into the great question of the subsequent training of the men. The subject of subsequent training, however, is to a great extent inseparable from that of the preliminary training, as the whole should be progressive throughout the service.

It seems advisable therefore that a board be appointed to consider this question in all its bearings and to formulate a Naval Training Policy.

In accordance with the conclusions heretofore stated, a general policy for the enlisted force of our navy on the following lines is suggested, these points being believed to be salient ones in a reasonable, systematic and cohesive policy.

1. That thorough training of the personnel is a recognized necessity. The day that sees the stoppage of all enlistments save "for training" under a real system will be a red-letter day for the service.

2. That this training shall include all recruits and all men in the service until they reach an established standard of proficiency which shall be strictly observed. Schools and courses of advanced training and instruction shall be maintained for the higher class of men.

3. That to make this training certain and uniform, a general training system shall be established with one head having authority over all parts of it and responsibility for all results.

4. That this system must provide for a certain preliminary training for each recruit before he is admitted to the general service. This training to be provided by a branch called the Training Service for Recruits.

5. That this training for recruits shall consist of a number of training stations with sufficient auxiliary vessels.

6. That a standard type of an efficient training station shall be outlined and all future ones constructed after this model.

7. That the number of recruits required yearly by the service shall determine the number of such stations to be constructed, there being a uniform capacity and output for each of these stations.

8. That in case of future increase of the enlisted force of the service a sufficient number of stations to produce these trained recruits shall be provided for.

9. That these stations shall be distributed over the country reaching all parts of it, the country being divided into districts for this purpose.

10. That enlistment should be for a longer period than at present; that the recruit should serve long enough to repay the government for his training; and that men who wish to receive the advantages of advanced training should be required to enlist for continuous service. Much of this is impossible of accomplishment at once, but every effort should be made to work toward this end gradually.

11. That pay and rewards shall be correspondingly increased, pensions for short and long service given, and everything done to retain good men in the service. There must be a recognized system of punishments, liberty, and leave.

12. That for the best interests of both the service and the men, recruits should enlist young. As long as the present shortage of men exists an older class may be accepted, but all

should receive identically the same training, with a gradual working towards the younger class as the mainstay of the service.

13. That the standards throughout the service shall be high, the discharge of those found unfitted for the service being obligatory, unlimited, and summary.

14. That standard requirements for each rate shall be insisted on, and no one advanced in rate without fulfilling every requirement and possessing every qualification. Let it be possible for every man to advance to the rate of "seaman" as soon as qualified; and let any man qualify for next higher rate and be placed on a waiting list until a vacancy occurs.

15. That every exertion be made to increase efficiency of petty officers, that we may have men with an educated sense of responsibility and with a proper habit of command, not given to doing a seaman's work on a petty officer's pay; but able to make twenty men do twenty men's work and do it quietly and properly.

6. A General Scheme for a Uniform System of Training Recruits.

A complete system of training for the service would properly be under control of an office which, as has been suggested, could be called the Office of Naval Training.

This Office of Naval Training should be established with the officer in charge of the personnel of the service (the Chief of the Bureau of Navigation at present) as the head, and should have its work subdivided as follows:

1. The Naval Training Service for Recruits.

2. Subsequent Training and Schools of Instruction.

3. Enlistments, Discharges, and Records of the General Service.

The Training Service for Recruits should consist of the following component parts:

(a) A Head Office.

(b) A number of Unit Training Stations.

(c) An efficient Corps of Instructors.

(a) The Head Office should consist of:

A Rear Admiral in command, Chief of Naval Training Service.

A Chief of Staff, senior to the Commandants.

A Lieutenant-Commander or Lieutenant as Flag Lieutenant.
A Lieutenant or Ensign as Flag Secretary.

The head of the Naval Training Service for Recruits should be known as the Chief of Naval Training Service and should have control of all stations, station ships, and auxiliary or other training ships and should have the same relative authority as the Superintendent of the Naval Academy.

The head office should keep the general records of all training stations and of all instructors, as well as a roster of all officers and instructors having experience in the training service.

The Chief of Naval Training Service should be required to inspect each station at least once a quarter, and should encourage competition between the stations.

The Head Office should have the responsibility of printing and publishing all books of regulations, all routines, all instruction books and cards, etc., for all the stations, and no changes in official routines should be permitted without the sanction of the Chief of Naval Training Service. The commandant of each station should be responsible that the system is carried out to the letter; and should, if any question of importance arises, require the Academic Board of the station (consisting of the executive officer and the heads of departments) to submit a written report on the subject to be forwarded with endorsements to the Chief of Naval Training Service. If the matter be of sufficient importance the Chief of Naval Training Service should call for reports on it from each of the stations; and if necessary convene the Training Service Board, consisting of himself, his chief of staff, and the commandants of the training stations, with a member of the staff as secretary, and with power to call before them any officer on duty in the training service.

The individual records of recruits should be kept at the stations, but the general records of stations at the head office.

(b) A number of unit training stations.

These stations should be identical with barracks, station ships, auxiliaries (sailing for seamanship and steam for gunnery), and depôt ships. The present systems, apprentice and landsmen with their independent cruising ships, should be replaced by these unit stations with auxiliary vessels.

With these auxiliary vessels always in touch with the station,

much more certain and uniform training will be had, and the system will be far more elastic and open to improvement and developments in the future without loss of efficiency.

Two classes of recruits should be enlisted, one at from 15-18 years of age and another at from 17-20 years of age. All should however receive the same training without mixing such diverse ages at the same station.

The number of such stations to be built is to be determined by the number of recruits needed for the service yearly. With a unit type of barracks, identical in plan and organization with every other, a definite and uniform result can be obtained, and no loss of efficiency will result in shifting officers and instructors from one to another, while orders and regulations devised for one station will apply equally well to all.

(c) An efficient corps of instructors.

This is one of the most important items; without it no real results can be obtained. A careful record of the performance of all instructors should be kept, and none be retained at the stations who fall below the mark in efficiency or conduct. At the same time merit should be rewarded and additional compensation given for possessing the necessary qualifications and holding the certificate of an instructor. A petty officer sent to the station for this purpose should be allowed six months to qualify for one of these certificates, but if not qualified by that time should not be retained.

After the system has been working a reasonable length of time no petty officers should be ordered as instructors unless holding a certificate as such. From then on, such certificates should be issued only at the Petty Officer Schools.

There should be temporarily attached to each station as a depôt ship, a battleship or cruiser. The graduates only would be put aboard and would keep the ship in good condition while awaiting examination, and would incidentally learn something of the arrangement and internal economy of a modern vessel.

For the purpose of covering the country systematically in recruiting and for reducing the length of travel, the whole United States should be divided into recruiting districts with, in time, one or more training stations to each district. The following arrangement would be a convenient one:

1. The Northern District, embracing the portion east of the

Dakotas and Nebraska and north of the 40th parallel. It may be necessary to divide this district into two, the northern and northeastern.

2. The Middle District, embracing the portion south of the above to the southern boundaries of Missouri, Tennessee, and South Carolina.

3. The Southern District, embracing all the Gulf States and including Kansas and New Mexico.

4. The Northwestern District, embracing the portion west of No. 1 and north of California, Nevada, Utah, and Colorado.

5. The Southwestern District, embracing the remaining portion.

Five stations, producing over 6000 graduates yearly, would more than replace the present systems and be more satisfactory. The Northern District would include the Lake region, where there has been a move to establish a training station. This site may be useful in reaching a region where are many possible recruits, but it is handicapped, as Newport is, to a large extent, by weather and climatic conditions, which prevent outdoor drills for several months in the winter and which cause much pneumonia and kindred diseases among those who have been previously ill-nourished. At present, however, large drafts come from the Lake country and the distance to the present station at Newport does not seem to interfere seriously with enlistments, Chicago and St. Louis being the largest recruiting rendezvous after New York. For many reasons it would be better to put the next station somewhere else.

It is inevitable that a number of new stations will be found necessary in the future, and it is the intention later on to advocate certain localities especially well fitted for this purpose.

We have at Newport a station capable as it stands of turning out about 1000 graduates a year under the proposed system. A few alterations would allow 1200-1300 to be turned out. This is believed to be the limit of efficiency for a unit training station, this meaning nearly 2000 recruits under training at the station at one time; beyond this number no enlistments for this station should be made. It is not believed to be advisable to further increase the size of such a station, rather that new ones be established reaching new material in other parts of the country.

An increase in the number of recruits to be handled in the

inevitable epidemics is not desirable, and a moderate limit makes for greater general efficiency. A larger body of recruits would be unwieldy and officers and instructors could know but few except those directly under them. Heads of departments could no longer follow the individual instruction even on paper. A further increase in the size of a station would inevitably result in the forming of several subordinate stations within the main station, and would not be more economical in officers or men. It certainly would not conduce to greater efficiency. Another barracks alongside of one already established would be like foreign territory in which extradition papers would be necessary to recover a recruit adrift. In time of war too it would be better to have stations scattered about the country.

A roster of officers for the training service should be made, and a plan formed for the junior officers alternating at the station and on the auxiliaries, the auxiliaries to count as sea service; and every effort should be made to make this service desirable.

Quarters for all officers should be built at every station. It is false economy to compel officers to live three miles from their work, putting a premium on early closing and insuring as late an arrival as possible. Officers living on the station would voluntarily and unconsciously do much more work, and their presence would always have a good effect on the recruits.

The enlistments for this system should be under two heads, as follows:

Between ages of 15 and 18 years as apprentice 2d class, at stations for boys at $10.00 a month pay.

Between ages of 17 and 20 years as apprentice, 1st class, at stations for youths at $15.00 a month pay.

These enlistments should be for four years from age of 18 years or from date of enlistment when over 18 years of age.

The course of instruction would last about 14 months, 3 months of this being spent on the auxiliary vessels and one month on the depôt ship, all the time directly under the control of the commandant. This is about the length of the present course of training of an apprentice.

At graduation the apprentice 2d class would become apprentice 1st class at $15.00 pay.

At graduation the apprentice 1st class would become seaman apprentice at $19.00 pay.

They would go to regular ships in these rates. When 18 years of age the apprentice 1st class should be rated a seaman apprentice.

Any seaman apprentice who has been six months on board a cruising ship and is qualified should be rated seaman, 2d class.

Any seaman, 2d class, who has been one year on board a cruising ship and is qualified should be rated seaman.

Before discharge all should be given opportunity to take up continuous service papers under a new system to carry pension of say one-fourth pay at 38 years of age, of one-third pay at 45 years of age; and one-half pay at 50 years of age.

After serving four years they should be discharged with provisions as now that if they re-enlist within four months they are to get the pay for that time.

They should re-enlist at the training station from which they originally graduated or be transferred there as soon as possible. Here they should be given at least one month's work in rigging loft, at squad, company and battalion drills, and on auxiliaries to prepare for examination. They should then be examined and their records completed. This makes it possible to arrive at some estimate of the results of the station work. Then a number, say 20 per cent, should be selected for the Petty Officer Schools or other technical schools, and the remainder drafted into service as seamen.

A small percentage of those selected for petty officers should be given special training afterwards for warrant officer and opportunities given for work on tugs, etc.

Petty Officer Schools should be maintained at each station, as it is at such places that these men under training have an opportunity to acquire and to exercise the habit of command which it is considered so desirable to develop.

It is believed that such a cohesive system with uniform organization, routines, and methods will produce far better results than the present one and will give a large number of petty officers very valuable training, greatly increasing their efficiency. The whole body of men of the lower rates will be rapidly leavened by a mass of recruits of a higher type than at present, with an educated sense of responsibility and a real respect for authority.

7. The Economics of the Question and the Saving in Officers and Men.

At present the most typical system we have is the apprentice training system with barracks and station ship at Newport and with three cruising ships taking the product of the station. This system sends into the service about 1200 apprentices yearly.

There are on duty at this station and on the three ships the number of officers and men shown in the table given below.

By doing away with the independent cruising ships and substituting auxiliaries as seems necessary and as advocated by many officers, the station at Newport would turn out the same number of apprentices with more elasticity in the system for increasing this number.

These graduates would be as well or better trained than at present with a much smaller expenditure of officers and men, as will be shown in the following tables.

Allowing one lieutenant, one ensign, and one boatswain to each sailing auxiliary and one lieutenant and one gunner to each gunnery auxiliary, we get the following for each system, as will be shown in detail later.

Where.	Captains or Commanders.	Lieutenant-Commanders.	Lieutenants.	Lt., Lt. J. G., or Ensigns.	Medical Officers.	Pay Officers.	Chaplains.	Mates or Boatswains.	Gunners.	Carpenters.	Warrant Machinist.	Men.
Proposed system ...	1	2	9	4	3	2	1	5	5	1	4	225
Present system	4	6	12	12	7	4	3	10	7	3	2	500

A saving of
- 3 Captains or Commanders,
- 4 Lieutenant-Commanders,
- 11 Lieutenants, Lieutenants, J. G., or Ensigns,
- 4 Medical Officers,
- 2 Paymasters,
- 2 Chaplains,
- 5 Boatswains,
- 2 Gunners,
- 2 Carpenters,

and about 400 men, with only a shortage in the warrant machinist class.

This is just enough for another complete station. The two stations under the new system would produce at least double the number of graduates turned out at present, and with infinitely more uniform results. Or, if necessary, here are enough officers to man several ships and men enough to form skeleton crews to be filled up by the products of the training stations later.

More stations, however, will certainly be needed in the future as the service is steadily expanding.

With the officers and men from the San Francisco Training Station and from the ships on duty with that station added to those enumerated above, a Staff for the Naval Training Service can be organized and two full stations as described be put in operation, turning out at the limit 2600 graduates a year, and still there will be left a considerable number of officers and men as shown by the following list:

Saving of officers—

1 Captain or Commander,
1 Lieutenant-Commander,
6 Lieutenants, Lieutenants, J. G., or Ensigns,
4 Medical Officers,
2 Paymasters,
2 Chaplains,
2 Boatswains,
1 Carpenter,

and approximately 500 men.

More than enough to man a battleship; and with only a shortage of 4 warrant machinists for the two stations.

Now let us take up the landsmen training system; this will not give as good a showing in saving of officers, but in reality there will be great advantages here also.

The reasons for the smaller proportional number of officers used in this service to the number of graduates, are, first, the fact that few officers are on duty at the shore station, there being little regular barrack training, a distinct loss; second, that the large steamers carry such a great number of recruits (nearly twice as many as most of the other ships), another loss of efficiency in instruction; and, third, that the whole time of the training of the recruits in this service is much shorter than that of the apprentices, still another loss in training.

The result therefore must be to produce an inferior article, not to be offset by their greater age and weight. Indeed in the long run there is little doubt that the younger class will prove of greater value to the service.

The expense of the landsmen service in engineer's force and coal must be comparatively very great.

If these ships were done away with and stations built with auxiliaries to take their place, the following would be the result.

There are at present on duty in this system and on the 8 cruising ships the number of officers and men shown in the following table:

Where.	Captains or Commanders.	Lieutenant-Commanders.	Lieutenants.	Lt., Lt. J. G. or Ensigns.	Medical Officers.	Pay Officers.	Chaplains.	Mates or Boatswains.	Gunners.	Carpenters.	Warrant Machinists.	P. O. and Men.
Landsmen Training Service	..7	8	23	11	8	7	3	12	10	6	13	about 800

The number of men turned out yearly is, at present, about 3000.

Two stations such as have been described will turn out about 2600 graduates at the limit, but of much superior training; and, undoubtedly, many more of them would be retained in the service.

The two stations will require twice the number of officers and men given in the first table with the addition of the staff. The staff already mentioned will serve for the whole system no matter how many stations there be.

This will be a saving of the following officers and men:

5 Captains or Commanders,
4 Lieutenant-Commanders,
5 Lieutenants,
3 Lieutenants, Lieutenants, J. G., or Ensigns,
2 Medical Officers,
3 Paymasters,
1 Chaplain,
2 Boatswains,
4 Carpenters,
5 Warrant Machinists,
and about 400 men.

With the surplus from the apprentice system added to these

and the deficiency in that service in warrant machinists supplied we have the following left over:

6 Captains or Commanders,
6 Lieutenant-Commanders,
11 Lieutenants,
3 Lieutenants, Lieutenants, J. G., or Ensigns,
6 Medical Officers,
5 Paymasters,
1 Chaplain,
4 Boatswains,
5 Carpenters,
1 Warrant Machinist,

and about 900 men.

Nearly enough officers to man another station and to turn out over 1200 more graduates yearly. This would make five stations turning out annually from 6000 to 6500 well-trained recruits with practically the present number of officers. The cost of the buildings, etc., would in part be offset by the release of 12 or more expensive ships.

If four stations were considered enough with their 5000 graduates a year, *then 3 battleships could be manned with the officers left over;* and, it seems that at present these 4 stations would be able to supply the navy's regular needs, barring any sudden increase in the enlisted force.

The following table shows the number of officers and men required for each number of unit stations from 1 to 5, as well as the total number now in the training service; and, also the probable number of yearly graduates by the proposed and the present systems:

Where.	Rear Admiral.	Capt. or Comdr.	Lieut.-Comdr.	Lieutenant.	Lt., Lt. J. G., or Ensign.	Medical Officer.	Pay Officer.	Chaplain.	Boatswain.	Gunner.	Carpenter.	Warrant Mach.	P. O. and Men.	Yearly Graduates.
Staff	1	1	1	..	1	..	..	..	..	..	..	..	...	....
1 Unit Station	..	1	2	9	4	3	2	1	5	5	1	4	200	1200-1300
2 " "	..	2	4	18	8	6	4	2	10	10	2	8	...	2400-2600
3 " "	..	3	6	27	12	9	6	3	15	15	3	12	...	3600-3900
4 " "	..	4	8	36	16	12	8	4	20	20	4	16	...	4800-5200
5 " "	..	5	10	45	20	15	10	5	25	25	5	20	...	6000-6500
Now in whole Training Service	1	13	18	38	29	18	13	7	24	20	9	17	...	4000-5000

The present system is too expensive if proper results are to be attained, the navy can not spare the officers or men. Yet a need for systematic training exists to-day, daily growing in urgency. The finger of Necessity points the way; some such system as outlined seems inevitable, and the sooner we recognize this and establish a uniform system the better it will be for the service.

8. Subsequent Training and Petty Officer School.

The training of the personnel of the navy should be continuous and progressive during the whole term of enlistment.

Some adjustment of present laws should be made to give the two classes of recruits an equitable and uniform system of advancement in rating. The present pay-table has many inconsistencies.

A board should be in session frequently on every ship for the purpose of examining candidates for promotion, and none should be so promoted without qualifying in every subject required.

These records should be carefully kept and quarterly reports should be forwarded to the Office of Naval Training.

The laws governing the special training of recruits throughout the service are good and definite enough, though no uniform, detailed course of instruction has been laid down.

The laws governing the examination of recruits before enlistments are stringent enough; but, especially in the cases of apprentices, their execution leaves much to be desired, saddling the service with many useless specimens which cost time and money before they can be gotten rid of.

Great advances have been made in regard to ratings and rewards for efficiency, and many excellent regulations relating to these subjects exist; but, it is thought that these may be further systematized to advantage. It is believed that buglers and bandsmen should enlist as boys for such training for a long term of enlistment and should be classified as are other rates. Chief buglers would be the bugle instructors. At present our aged and decrepit bandsmen are fit only for bandstands, concerts, and theatres.

A perfect system of identification by physical characteristics is much needed in the service, and with the card index systems

of to-day can be installed and used at every recruiting station with little expense or loss of time, while the gain to the service in preventing re-enlistments of "undesirables" would be very great.

The regulations governing the instruction and marking of men and recruits are sufficient but too general, and it is believed that the system of marking should show not simply the opinion of some officer as to a man's ability in his rate, but should be an absolute measure of his qualifications. Thus, say that there are a hundred items which go to make up the sum total of a seaman's necessary qualities, then let him be marked on a uniform scale one point for each thing he is qualified in. The enlistment record will then show the subjects not qualified in, and next quarter he need only be examined in these subjects. The number of points accomplished can then be added to the previous mark as shown on the record. A general review examination might be held once a year. On the whole this system would be simpler and in the end quicker than the present method, and, if adhered to strictly, would promote ambition among the men; who, knowing the requirements, would endeavor each quarter to improve their marks. It would also enable the officers to size up the men to better advantage and would insure their having the standard qualifications for the rate held. We would not then see so many seamen who cannot splice wire rope or send a signal message, nor would we have ordinary seamen who cannot go aloft or steer the ship. A rearrangement of subjects on the enlistment records should also be made and marks should not simply represent a quarter's work, but should express the value of the man in each one of the branches. Some such classification as the following would, it is believed, stimulate them to perfect themselves in all directions:

1. Character—Subdivisions: Ability to command; appearance; bearing and neatness; subordination; attention to duty.

2. Ability—Subdivisions: Seamanship, signals, ordnance, marksmanship, schooling, special courses.

3. Conduct—One heading is sufficient.

Any seaman or petty officer, recommended by the Board of Officers and the commanding officer of a ship for a course at a Petty Officers' School or other school of instruction, should if

possible be allowed to take the course; and every ship should, when in home waters, be compelled to select each quarter the two most deserving men on board for this purpose, their places to be filled by graduates of the said schools when possible.

These instruction schools are excellent in conception, and only need encouragement and enlargement to meet all the needs of the service.

A Petty Officer School should be located at each of the training stations. The auxiliaries proposed would also give excellent opportunities for acquiring knowledge and experience which they would never otherwise get in the modern service. Here they would assist in the handling of the recruits, meanwhile learning to command men themselves.

Every effort should be made to make a petty officer one in fact as well as in name; that is to make him an officer of a lower rate exercising the command vested in him and receiving the respect due him; with a real sense of duty and a self-respect holding him above the mass of men. It is well to increase in every way the deference shown by the men towards the petty and warrant officers, and to increase the separation between all classes. Petty officers being *of the men* themselves and understanding all their modes of thought, while at the same time they possess sufficient intelligence and training to appreciate the position of an officer, are in the proper situation to stand between these extremes, and indeed are the greatest factor in maintaining proper discipline; they are in every sense "the backbone of the Navy."

Before leaving this subject it is impossible to pass over one of the greatest needs of the navy to-day—a longer term of enlistment. It has been said that men cannot be gotten to enlist for such long terms, but this is not yet fully proved. At any rate, having in view the great advantages to be derived, it would be worth while to make the experiment. Without changing the regulations governing the mass of enlistments to-day, a special class of enlistments might be accepted for a long term carrying a life pension after expiration of enlistment, with an increase of pension for each subsequent enlistment. It is believed that there is a large and growing class of men who regard the navy as their home who would take advantage of this offer, and even if all did not re-enlist for the second term they would thus form a

large and valuable reserve, bound to the service and in its pay, to be called on in time of war.

9. Good Methods and Bad.

With longer and more thorough training more men would be retained in the service, as they would not so readily abandon a profession in which they were well on the way to efficiency and success.

The raising of the standard would not only exclude much undesirable material, but would attract a better class. This is especially true of apprentices whose parents are often afraid of evil associations. It is false economy to retain a single recruit recommended for discharge. The navy regulations explicitly prescribe that *all* apprentices unfit for the service shall be recommended for discharge. From experience it is believed that no boy really fit for the service has ever been recommended for discharge under this head; and it is certain there are many so-called graduates of both systems whom the navy could spare with advantage to itself. It is believed that a much higher class of recruits will enlist as the standard of the system rises and its reputation spreads. The sympathetic instincts often aroused should not control; the training stations are not charitable institutions, but are designed solely to supply the navy the best material obtainable; and the only duty of the officer is towards the service.

As for the instruction, the methods are of the greatest importance and a few facts will be noted here which are well to bear in mind in organizing a model training station.

1. It is far better to have few and simple requirements, the elements of the profession, and to really acquire them, than to have an elaborate schedule on paper, impossible of realization, causing a slurring over of important things, and resulting in a confusion of ideas with no well defined qualifications.

2. A youth cannot grasp a large subject in all its parts at once —it must be presented to him in small portions and one at a time. A real synthetic method is the proper one.

3. With this class of recruits repetition, reiteration, time and patience are the important forces in impressing facts upon the memory. As Commodore Bunce (quoting from Lieutenant-Commander Clark's article) so justly observed some years ago,

"Training apprentices is best done by the repetition of facts until they are impressed on the memory and by the repetition of acts until facility in doing them is acquired."

4. Under all departments a reasonable length of time should be allowed on each subject for the average recruit to master it before progressing to any other. Trying to teach beginners a different branch of a subject daily is a great mistake.

5. The best class of instructors are men with the faculty of imparting knowledge, with patience, with ability to command, and, above all, of good conduct and bearing. These are the only ones who should be allowed to instruct recruits. Such men by their example alone produce much effect; and recruits seeing these men, whom they look up to, carrying themselves as they should, come to believe their manner to be the recognized standard for all men on duty and carry this high ideal with them into the service. They also see the possibilities to which any one of them may easily rise within a few years.

6. A routine having been once established nothing should be allowed to interfere with it. Details of recruits to any duties which keep them from their regular periods of instructions are harmful and should be avoided.

7. Every moment of the time under instruction must be utilized. Under a carefully worked out system, in a properly constructed barracks, it is easily possible to save on many a day an hour which is often wasted by faulty arrangements, by times spent in marching to and from or in getting out apparatus, etc. This point was well brought out in the article by Lieutenant-Commander Clark referred to above.

8. General drills for the instruction of recruits are a great farce. Individual instruction until all elementary work is accomplished is the only way to produce results. Drills held for the purpose of entering them in the log alone are a bad feature of any system.

9. The lecture system was not devised for such a school as we have under consideration, and to waste time droning along with a lot of matter to which many of the recruits are not even listening is little short of criminal.

10. Let each step forward have a reward in view be it ever so little; the youth can grasp this idea and will work for it. He can thus be led until, without his knowledge, he is trained to do things automatically.

11. Many officers criticise what exists without suggesting improvements or assisting in devising means to carry them out. It is easy to pull down—let them now come forward and assist in building up some system of which even they can approve.

10. The Unit Training Station.

Each unit training station should be complete in itself, and, as nearly as may be, each should be identical.

For convenience this subject has been divided into a number of heads which will be considered in order, as follows:

(a) General organization.
(b) Enlistments for the station.
(c) Details of organization.
(d) Administration.
(e) General schedule of course.
(f) Details of course of instruction.
(g) Records.
(h) Plan for general arrangement of station.
(k) Plans of barracks.
(l) Proposed sites.

A. GENERAL ORGANIZATION.

The unit station should comprise the following parts:

Barracks,
Newcomers' quarters,
Sterilizing plant,
Station and depot ships,
Auxiliary training vessels,
Boats and boat houses,
Ferry tugs and launches,
Workshops,
Officers' quarters,
Hospitals,
Drill and recreation grounds,
Target ranges,
Chapel or auditorium,
Gymnasium,
Swimming pools,
Marine barracks.

A captain or commander should be commandant of the station and should be directly responsible to the Chief of Naval Training Service.

The instruction should be carried on under the department system, the following departments being necessary:

Department of Discipline,
Department of Seamanship,
Department of Tactics,
Department of Gunnery,
Department of English.

The following officers will be needed for such a unit station:

1 Lieutenant-Commander—Executive officer, head of Department of Discipline, senior member of Academic Board, in general charge of station ship, barracks, grounds, launches, workshops, etc.

1 Lieutenant-Commander or Lieutenant—Head of Department of Seamanship, member of Academic Board, in charge of 1st division, sailing and pulling boats, instruction on sailing auxiliaries, and should be senior to all officers on these.

1 Lieutenant—Head of Department of Tactics, member of Academic Board, in charge of 2d division, in charge of battalion, gymnasium, physical exercise, parades, etc.

1 Lieutenant—Head of Department of Gunnery, member of Academic Board, in charge of 3d division, ordnance officer of station, in charge of instruction on gunnery auxiliaries, and should be senior to all officers on these.

1 Lieutenant—Relief for heads of departments, secretary of Academic Board, in charge of records, in charge of 4th division, adjutant of the battalion of infantry and artillery.

1 Lieutenant—In charge of newcomers' squad and building, assistant to each head of department in the departmental work of his squad.

1 Chaplain—Head of Department of English, in charge of school, library, and music rooms, and of post office. To deliver lectures and to provide entertainments for the recruits.

All work in any department is to be absolutely under control of the head of that department. Paragraph 55, U. S. Navy Regulations 1900, should most certainly be construed as applying to this case.

There will be needed on each of the sailing auxiliaries the following officers:

1 Lieutenant in command,

1 Lieutenant, J. G., or Ensign as watch officer.

These would be most excellent schools for midshipmen, and no better experience could be gained by them than this.

There will be needed on each gunnery auxiliary, the following officers:

1 Lieutenant or Lieutenant, J. G., in command.

The warrant officers needed under the system will be as follows:

1 Chief Boatswain on station ship and for general station work. To assist in Seamanship Department when possible.

1 Boatswain in Department of Seamanship, assistant in 1st division.

1 Boatswain or Gunner in Department of Tactics, assistant in 2d division.

1 Gunner in Department of Gunnery, assistant in 3rd division.

1 Carpenter for station work, assistant in 4th division.

1 Warrant Machinist in charge of station plant.

3 Boatswains, one on each sailing auxiliary.

3 Gunners, one on each gunnery auxiliary.

3 Warrant Machinists, one on each steam auxiliary.

All warrant officers are to be available for duty as company officers, etc., at battalion drills of the infantry and artillery.

There will also be needed for a unit station in the Medical and Pay Departments the following officers:

1 Surgeon or Medical Inspector in charge of Station Medical Department. The hospitals are not included in this estimate as they are usually separate commands.

2 P. A. Surgeons or Assistant Surgeons as assistants in the department and to attend the auxiliary vessels.

A sufficient force of pharmacists, hospital stewards, and hospital apprentices. This is a prime necessity, both on account of the numerous and trying epidemics and of the immense amount of work entailed by the frequent examinations.

In the Pay Department the following will be needed:

1 Paymaster or Pay Inspector in charge of Pay Department of station, general storekeeper, and commissary of apprentices.

1 P. A. Paymaster or Assistant Paymaster as assistant in department, oversee work on auxiliaries.

A sufficient force of pay clerks, pay yeomen, and helpers.

A sufficient force of commissary stewards, commissary yeomen, chief cooks, bakers, and sufficient landsmen mess cooks for the barracks and three auxiliaries to avoid the necessity of employing apprentices for this purpose.

The number of petty officer instructors that will be required for a unit station under this system will be as follows:

37 for the barracks, divided as follows:

16 in the Department of Seamanship,
12 in the Department of Tactics,
8 in the Department of Gunnery,
1 athletic instructor under the Department of Tactics.

There will be needed for the newcomers' squad the following:

10 for preliminary instructions in Departments of Seamanship and Tactics.

There will be needed on the auxiliaries the following:

18 for instruction in seamanship and in gunnery.

65 instructors in all for a unit training station.

This number can probably be supplied from the training ships now in commission, since it is not intended to use only chief petty officers. Many good 1st and 2d class petty officers can be found, and the opportunity for selection given by the doing away of the independent cruising training ships would be of great value.

The number of each class of petty officer needed is as follows:

40 Chief Petty Officers as follows: 18 at barracks, 4 at newcomers' quarters, 18 on auxiliaries.

13 1st-Class Petty Officers as follows: 10 at barracks, 3 at newcomers' quarters.

12 2d-Class Petty Officers as follows: 9 at barracks, 3 at newcomers' quarters.

These 65 should be made up of the following rates:

DEPARTMENTS.

12 Chief Masters at Arms, 2 Sea., 3 Tac., 1 New., 6 Aux.
11 Chief Boatswain's Mates, 4 Sea., 2 Tac., 2 New., 3 Aux.
5 Chief Quartermasters, 2 New., 3 Aux.
12 Chief Gunner's Mates, 5 Gun., 1 New., 6 Aux.

2 Masters at Arms, 1st class, 1 Tac., 1 New.
3 Boatswain's Mates, 1st class, 2 Sea., 1 Tac.
2 Quartermasters, 1st class, 2 Sea.
2 Boatswain's Mates or Gunner's Mates, 1st class, 2 New.
4 Gunner's Mates or Gun Captains, 1st class, 1 Tac., 3 Gun.
2 Masters at Arms, 2d class, 1 Tac., 1 New.
3 Boatswain's Mates, 2d class, 1 Tac., 2 Sea.
2 Quartermasters, 2d class, 2 Sea.
2 Boatswain's Mates or Gunner's Mates, 2d class, 2 New.
3 Gunner's Mates or Gun Captains, 2d class, 1 Tac., 2 Gun.

The number of chief petty officers given as needed at the unit station, exclusive of those required on the auxiliaries, is just about what is now allowed at the Newport station.

There will also be needed in the Department of English for the school, library, and post office the following force:

2 Yeomen, 1st class, one as librarian and one as postmaster, and to assist in keeping records and in maintaining order.

12 Schoolmasters, to be men enlisted for this particular purpose only, and not available for other duty. Good men can thus be secured at small salaries.

Under the Department of Discipline at the barracks, at the newcomers' quarters, and on the auxiliaries, will be needed a number of masters at arms for police duties; these men will not be instructors and need only be men of good character, but are necessary. A good police force goes such a long way towards promoting order and efficiency and preventing straggling that it would be false economy to cut down this number. There will be needed for this purpose:

1 Chief Master at Arms for station, in charge of all prisoners.

3 Chief Masters at Arms, one on first and one on second floor of barracks and one in charge of grounds.

4 Masters at Arms, 1st class, one on upper floor of barracks, one in charge of "Restricted Squad," one in charge of "Extra Duty Squad," one on station ship.

1 Master at Arms, 2d class, for mess hall, assisted by 2 seamen.

1 Master at Arms, 2d class, for head, wash room, and dry rooms, assisted by 3 seamen.

1 Chief Master at Arms at newcomers' quarters, in charge of building and grounds, assisted by 2 seamen.

3 Masters at Arms, 1st class, to assist in outfitting newcomers.

6 Masters at Arms, 1st class, for auxiliaries, one on each vessel, assisted by one seaman.

20 in all in this department.

There will be needed for the crews of the auxiliary sailing vessels approximately the following men:

2 Boatswain's Mates, 1st class,
1 Captain of Forecastle,
2 Captains of Top.
1 Captain of Afterguard,
2 Quartermasters, 1st or 2d class,
1 Quartermaster, 3d class,
4 Seamen. Some can also be detailed from the Petty Officer School.
2 Landsmen for captain of head and lamplighter.
15 in all for each sailing auxiliary.

For each gunnery auxiliary there will be needed the following men:

1 Boatswain's Mate, 1st class,
1 Captain of Forecastle,
1 Captain of Afterguard,
2 Gunner's Mates, 2d or 3d class,
2 Quartermasters, 1st or 2d class,
1 Quartermaster, 3d class,
2 Seamen,
2 Machinists, 1st class,
2 Firemen, 1st or 2d class,
4 Coal Passers.
18 in all for each steam auxiliary.

There will be needed for the station ship, ferries, launches, the boiler house, the dynamo room, workshops, etc., at the station, the following men:

4 Quartermasters, 2d or 3d class, on station ship,
4 Seamen, on station ship,
2 Landsmen, on station ship,
12 Coxswains, Seamen, Ordinary Seamen, and Firemen for launches,
6 Machinists and Firemen for boiler house,

5 Electricians for dynamo room,
8 Carpenter's Mates, Plumbers, Painters, etc., in workshops.
41 in all for station work.

This makes a total for the whole station, including the station ship and auxiliaries and the commissary and medical forces, of about 225 petty officers and men, exclusive of the instructors.

This is very economical as compared with the present force in the three sea-going training ships and at the Newport station, which is about 600 or more.

B. ENLISTMENTS FOR THE STATION.

It is particularly necessary that the greatest care be exercised in selecting recruits. Vicious and immoral boys do incalculable harm even during the short term of their existence in the navy. Poor, weak, physical specimens are of no use to the service and waste the time of officers and instructors. The number of cases admitted which even a casual glance shows are manifestly unfit for the service is unaccountably large. A good judge of character can always exclude many and save them and their families the disgrace of failure and dismissal. Much of the bad showing of the apprentices is due to the lack of care in enlisting. During the last year there were 2300 at the Newport station. Of these 230, or 10 per cent, were discharged for physical disability, before leaving the station, and within a few months (in some cases a few weeks) of their enlistment.

The navy does not want every boy that applies, only the best are good enough.

In connection with this service of recruiting it might be well to detail several trustworthy graduates from each recruiting district to act as orderlies at the recruiting office; they would attract and maybe even drum up enlistments. When the system becomes more thoroughly known and the real facts more widely disseminated it will bring many more volunteers. Never have there existed such opportunities for the graduates of such a system as to-day; any one with a little work and ordinary good behavior can become a warrant officer in a few years. And many of these ambitious ones may soon have commissions.

In case of war their chances would be proportionately greater. But to make this true in every case thorough training under a real system is necessary, to-day it is the apprentice who has the

shoulder straps concealed in his ditty box, the landsman is not in the race, and why—it is wholly a matter of an early start and of real systematized training.

To attract enlistments it must be thoroughly understood outside that this proper training will be given and that every one will be started fairly with an equal chance of promotion.

The limit of enlistments for a unit station under the proposed system should be fixed so that the number of recruits under instruction in barracks and newcomers' squad at any one time shall not exceed 1600; this number is an average of about 110 a month; beyond this no further enlistments for this station should be made.

Where it is found necessary to have training stations in the bleak northern and northeastern States, allowance should be made for this in the enlistments, by checking them in the fall, so that the station may not be crowded in the unhealthy winter season.

C. DETAILS OF ORGANIZATION.

All recruits upon arrival are to be placed in the newcomers' squad (the fourth class) and kept separate from the others; the battalion at the barracks being divided into three classes, first, second, and third. Each department is to be assigned a number of instructors besides the commissioned and warrant officers attached to it. The head of department assigns to each instructor his squad and subject, and prepares schedules in accordance with the station scheme of instruction.

The 1600 recruits are to be divided as follows:

400 in the newcomers' squad,
400 in the third class,
400 in the second class,
400 in the first class.

The number on the auxiliaries is to be limited to 120 to each pair or 360 in all, this being about the average number of the first class who will probably be found qualified for promotion. This makes nearly 2000 recruits attached to the station at one time if filled to the limit of its capacity.

The whole number of recruits in the barracks should be divided, as now, into four divisions, the officers and instructors being equally divided among them; this is for purposes of

inspection, clothing, cleaning, etc. Each division will then have 300 at the limit, and will be divided into two companies and four sections, the four classes being equally distributed to each section. In order to have an elastic working system suitable to all conditions there should be selected for watch numbers a total number large enough to allow for all contingencies. The numbers from 101 to 199 will be for the 1st section, 201 to 299 for the 2d section, and so on for the sixteen sections.

Numbers 1 to 100 will be for instructors and masters at arms.

Numbers 1700 to 2100 will be for the newcomers' squad.

The station ship, auxiliaries, and depôt ship will have their own numbers. All men on duty at the station except those named above to have station ship numbers.

This system of numbers for the recruits will show at a glance the class, division, company, section and mess.

The instruction of all classes is based on a course of three months in each class.

As nearly as possible there should be one instructor for each section of each class when under instruction in any given department, and this instructor should follow the same section through its departmental work. These sections have about 25 recruits in each. No instructor can handle a larger number properly and with the less experienced men this number would better be much reduced.

Thorough records must be kept, and by the end of the three months' term each recruit must have been given an opportunity to qualify in each subject. When he shows himself qualified in any subject he should be checked off in the record book with appropriate remarks. When qualified in all subjects of the class course he is ready for promotion, but should never be promoted until so qualified.

Any recruit in a lower class, who requests it, and is recommended by his divisional officer, should be given a chance to qualify for the next class. The Academic Board should decide this, and, if he succeed, should order his promotion.

Conduct should count largely in promotion, as far as holding up characters who are unfit for the service or not deserving of promotion, but the Academic Board should have discretion in these matters. A demerit system with marks, extra duty, and privileges corresponding as now in force at Newport, should be carried on under the Department of Discipline.

At the end of each term of three months the lists should be overhauled and all recruits qualified should be promoted to the next higher class.

Upon finishing the first class course all recruits qualified should be transferred to the station ship; and those deserving it should be given at least two weeks' leave to visit their homes. At the expiration of this leave they should be transferred to the auxiliary sailing vessels for a six weeks' course in seamanship. Upon completion of this course they should be transferred to the gunnery auxiliaries for a similar course in gunnery and target practice. If thought desirable to reduce the size of the complements of the auxiliaries still further for the purpose of more individual instruction, half of the advanced class can be sent to the seamanship and half to the gunnery auxiliaries in the start and then the two squads interchanged at the end of six weeks. This would be partly determined by the class of vessels available or decided upon.

During this time the recruits are still under the same system, under the control of the commandant, and under the supervision of the Academic Board, and any offender or any one found unfit for the service can at once be returned to the station and a deserving one who is qualified be sent in his place. This gives an immense superiority over the present system in keeping the graduating class filled to its limit with recruits who are available for the general service. It also allows additional preliminary training to be given those who have been found, through no insurmountable cause, not yet fitted for the service, and thus saves to the government the time, pay, and services of a number who would otherwise be discharged at a total loss. Prisoners also will not be kept on the auxiliaries longer than necessary to secure their transfer to the station cells and to have their places supplied by others more deserving. This power of reducing advanced recruits is the strongest hold possible to keep over them, and produces an alacrity and precision in their work which no other consideration seems to effect.

When the course on the auxiliaries is completed the class should be transferred to the depôt ship for final graduation and should be subject to the call of any department for this purpose. Meanwhile they would familiarize themselves with the details of a modern ship and at the same time keep her in good condi-

tion. The examination should be a rigid and comprehensive one including every subject taught at the station, and at its completion the Academic Board should report in writing to the commandant the result, and he will order the graduation of the successful recruits, the others being returned to the station.

On graduation day, which would occur every three months, the graduating class should be presented their certificates of graduation and the medal winners their medals at a dress parade of the whole battalion.

The graduates are then to be rated apprentices, 1st class, or in case of the older class, seamen apprentices, and then await transfer from the depôt ship to the general service, the number ready being reported by the commandant to the Chief of the Naval Training Service.

During this time leave should be again granted the deserving ones if possible, as such privileges do only good and there is no danger of desertions before going to the cruising ships to which all are eagerly looking forward. This is not said to be the case with the steamers taking large bodies of landsmen for a training cruise.

The following is a brief summary of the course of instruction as outlined above:

In newcomers' squad...........	½	to 2	months.
In third class.................	3	to 1½	"
In second class................	3		"
In first class..................	3		"
On leave......................	½		"
On sailing auxiliaries...........	1½		"
On gunnery auxiliaries..........	1	to 1½	"
On depôt ship under examination	1		"
Length of course..........	14		"

This is about the average length of time in the apprentice training service to-day, but a uniform system with proper selection as outlined will accomplish more in the same time.

The scheme throughout is to select the absolutely essential things and to make it certain that these are acquired before promotion.

D. DETAILS OF ADMINISTRATION.

The commandant of the unit training station should be the head of the school and responsible to the Chief of the Naval Training Service.

The executive officer should have charge of all the internal economy of the station besides having special charge of the conduct records of all recruits and control of all the police force of the station, as well as his usual duties as recruiting officer of the station. He is also head of department of discipline and senior member of the Academic Board.

The Academic Board should meet at least three times a week and take action on all cases laid before it by the heads of departments; and the board should prepare the class lists and keep them up to date as well as make up the reports of recruits to be graduated, promoted, reduced or discharged. For this purpose they should frequently and carefully scrutinize the existing lists and note all cases requiring their action. To this end heads of departments and divisional officers should be required to hand in weekly lists of any cases requiring action by the board. The records of the auxiliaries should also be transmitted through the heads of departments to the Academic Board whenever occurring. The board should decide all medal competitions and should require its secretary to keep all records up to date. The Academic Board should have power at any time to recommend the discharge of any recruit found to be unfit for the service, and it is their duty to make such recommendations in each case.

Heads of departments should keep careful records of all instruction and of the performance of all their instructors, and should be held responsible for the efficiency of their departments.

All instructors must be most carefully selected and observed and should only hold their rates during good behavior. They should each one have a tour of duty in the department of tactics at first in order to acquire a proper bearing, a habit of command, and some knowledge of the drill regulations, and all of them should be available for battalion drill.

To obtain efficient results the corps of instructors must at all times be maintained at its full strength. Since it is often very difficult to obtain the proper number of chief and other

ONE OF THE BRITISH SAILING AUXILIARIES BEATING OUT OF PLYMOUTH HARBOR.
COMPLEMENT—100 BOYS.

petty officers of the requisite qualifications for instructors, the following plan is suggested. Assign each station the proper number of rates of each class that has been decided upon as necessary. Then fill such rates as are possible with the petty officers available, allowing the different stations to select the others from petty officers of lower rates sent to the stations for the purpose and from the graduates of the petty officers' schools or from any men who may re-enlist at the station or who may develop among the men on duty there. These instructors' rates are to be given temporarily at the pleasure of the commandant, and these men to return to their proper rates upon transfer. This would be an excellent means of acquiring efficient men and of enforcing a strict attention to duty and a proper behavior. This time of service should count as Acting service in the next higher rate as required by the existing Navy Regulations.

All offenses and all punishments of recruits should be classified and, except for serious cases, should be assigned demerits which carry extra drill or duty; the demerits serving to determine the mark in conduct. This has been worked out at the Newport station and is in daily use there with good results. Punishments should be as summary as possible, and continually insubordinate, vicious, or immoral offenders should be kept separate from the others until their discharge can be effected. The retention of such characters for even a short time works great harm to many others. These discharges will reassure parents afraid to send their sons on account of the bad associates; and the cutting off of the early sea cruise will decide others afraid to send their sons so far from home at the start.

Confinement is not a good corrective in the case of many boys, the weeding out process is the only way with the "undesirables." The British navy obtains excellent results by the fear of the birch, and it is to be regretted that in the cases of young boys such measures are not permissible in place of the irons and confinement which seem to harden some of them and in other cases have no terrors for them.

Conduct classes would much better be known as grades, there being so many kinds of classes in the service as to be confusing.

E. GENERAL SCHEDULE OF THE COURSE.

The course of instruction should have definite dates for its beginning and end, and no recruit should under any circum-

stances be transferred to a cruising ship until he has been reported ready. For a station situated in the Middle States the following schedule is a convenient one. There is some modification necessary in the winter classes on account of the climate; for stations north of Chesapeake Bay this will be a considerable change.

GENERAL SCHEDULE.

Finish Course in					Leave.	Finish on Auxiliaries.		Graduate (on Depôt Ship.)
Newcomers' Squad.		Third Class.	Second Class.	First Class.		Sailing.	Gunnery.	
First Squad.	Second Squad.							
June 1.	July 15.	Sept. 1.	Dec. 1.	Mar. 1.	½ mo.	May 1.	June 1.	July 1.
Sept. 1.	Oct. 15.	Dec. 1.	Mar. 1.	June 1.	½ "	Aug. 1.	Sept. 1.	Oct. 1.
Dec. 1.	Jan. 15.	Mar. 1.	June 1.	Sept. 1.	½ "	Mar. 1.	Dec. 1.	Jan. 1.
Mar. 1.	Apr. 15.	June 1.	Sept. 1.	Dec. 1.	½ "	Feb. 1.	Mar. 1.	Apr. 1.

F. DETAILS OF THE COURSE OF INSTRUCTION.

The details of a course somewhat similar to the one at Newport but arranged to give as nearly as possible continuous instruction in each subject until qualified on it before progressing to the next, has been worked out with schedules, routines, etc.; but the limits of the present article do not admit of its interpolation here.

In the early part of the course more time is given to tactics and English, these being specially needed by raw recruits to brace them up and to permit of their progressing to the top.

Later more time is given to seamanship, this being the best opportunity to acquire a groundwork in this subject. Little time is given to gunnery during the early part of the course, this, however, is increased as the end of the course is neared.

It is hoped that in the future more stress will be laid on the work in the English department and more aid furnished this department. This course is especially necessary nowadays when an ability to read, write and figure is very essential to advancement through even the lower rates. To take an advanced course at one of the schools of instruction such knowledge is an absolute requisite. If all are to have an equal chance of rising to a position of responsibility such a course is imperatively demanded.

Voluntary night classes for those who are ambitious could easily be maintained with advantage.

The subject taught by each department is to be carefully analyzed and reduced to those elements which a recruit should be taught and every effort should be made to systematize the instruction so that there should be no waste of time and so that no recruit will be overlooked or fail to get instruction in every part of the course. The work throughout should be progressive, one portion being learned before another is taken up.

In each department instead of frequent examinations, which break into the routine and are, in the case of large numbers, seemingly interminable, record books with list of qualifications for each class should be kept and a system of checking off those qualified should be made.

The work on the sailing auxiliaries should be given up entirely to seamanship; they should have no guns on board. Boat work is one of the best schools for the modern seaman and great stress should be laid on this part of the course.

The best type of auxiliary sailing vessels is a matter to be decided upon when the system is outlined, but certain requisites seem clearly indicated, and these point in the direction already followed by the British.

These vessels must be comparatively small and handy, capable of being handled with ease and safety in contracted bodies of water and by small crews.

They should combine as lofty masts and as much square sail as possible for purposes of instruction and gymnastics.

The Newport class does not possess these, and under the proposed system sailing vessels are better and cheaper for teaching seamanship.

A complement of 120 recruits is the unit worked out in the system proposed. A bark or a brig of say 600 to 800 tons seems the type needed. The brig has been found most efficient in England.

These vessels should leave port daily in suitable weather and return to their moorings in the afternoon. Alacrity in obeying orders and quietness in performing work should be rigidly insisted upon.

Competitive drills at stated periods between these vessels, identical in everything, would produce excellent results, and this would be a great school for the young officer.

Any convenient and handy steamer of small size and moderate draft will do for the work of gunnery auxiliary. Many of the yachts purchased during the war are well fitted for this purpose. Each one of these vessels should carry the following battery:

1 4-in. R. F. G.
2 6-pdr. R.F.G.
2 3-pdr. R. F. G.
2 1-pdr. R. F. G.
4 automatic guns.
120 service rifles.
40 service revolvers.

and all sighting apparatus, sub-calibres, targets, etc., and unlimited ammunition.

G. RECORDS.

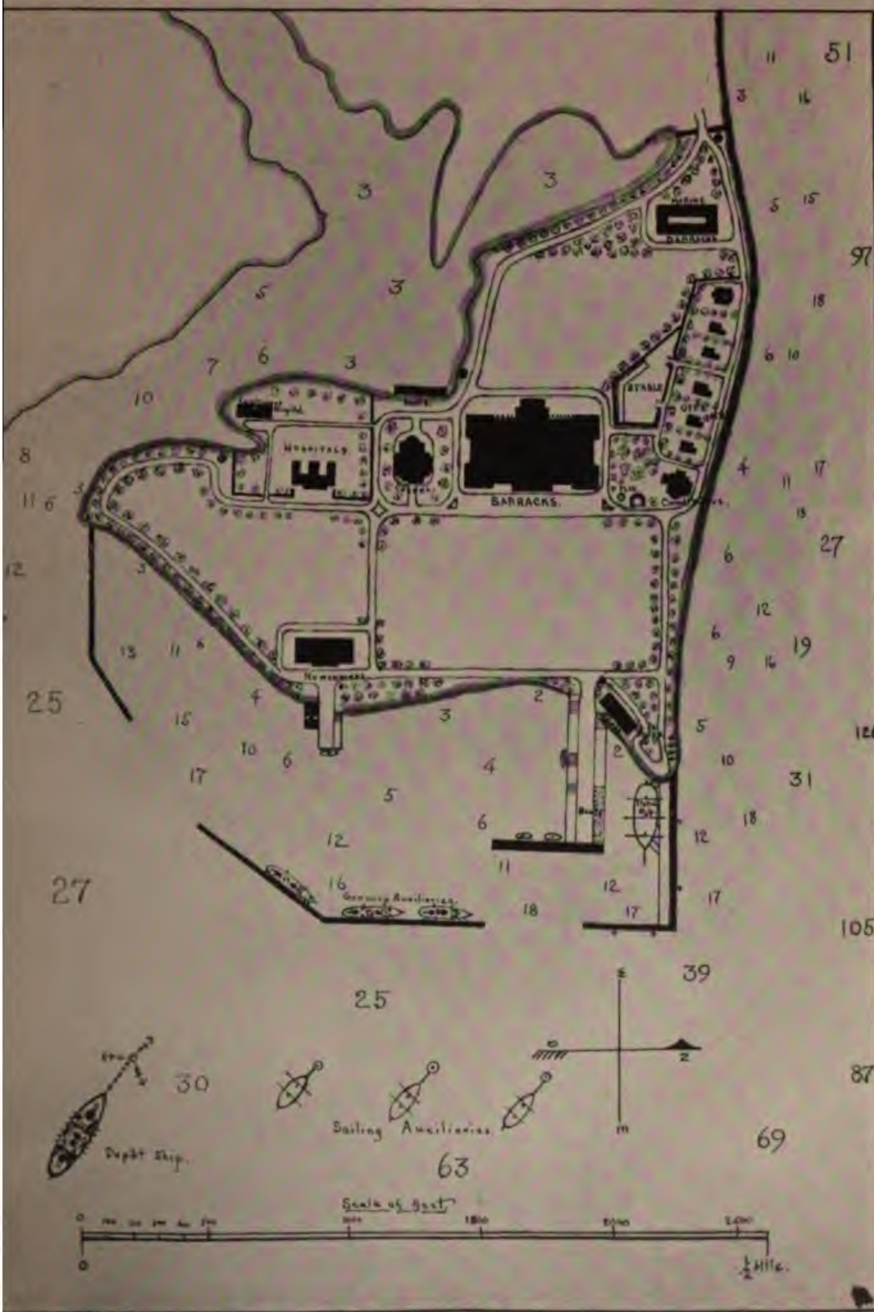
All records of the instruction of each recruit from enlistment to graduation should be kept in one general card index system in the office of the Academic Board.

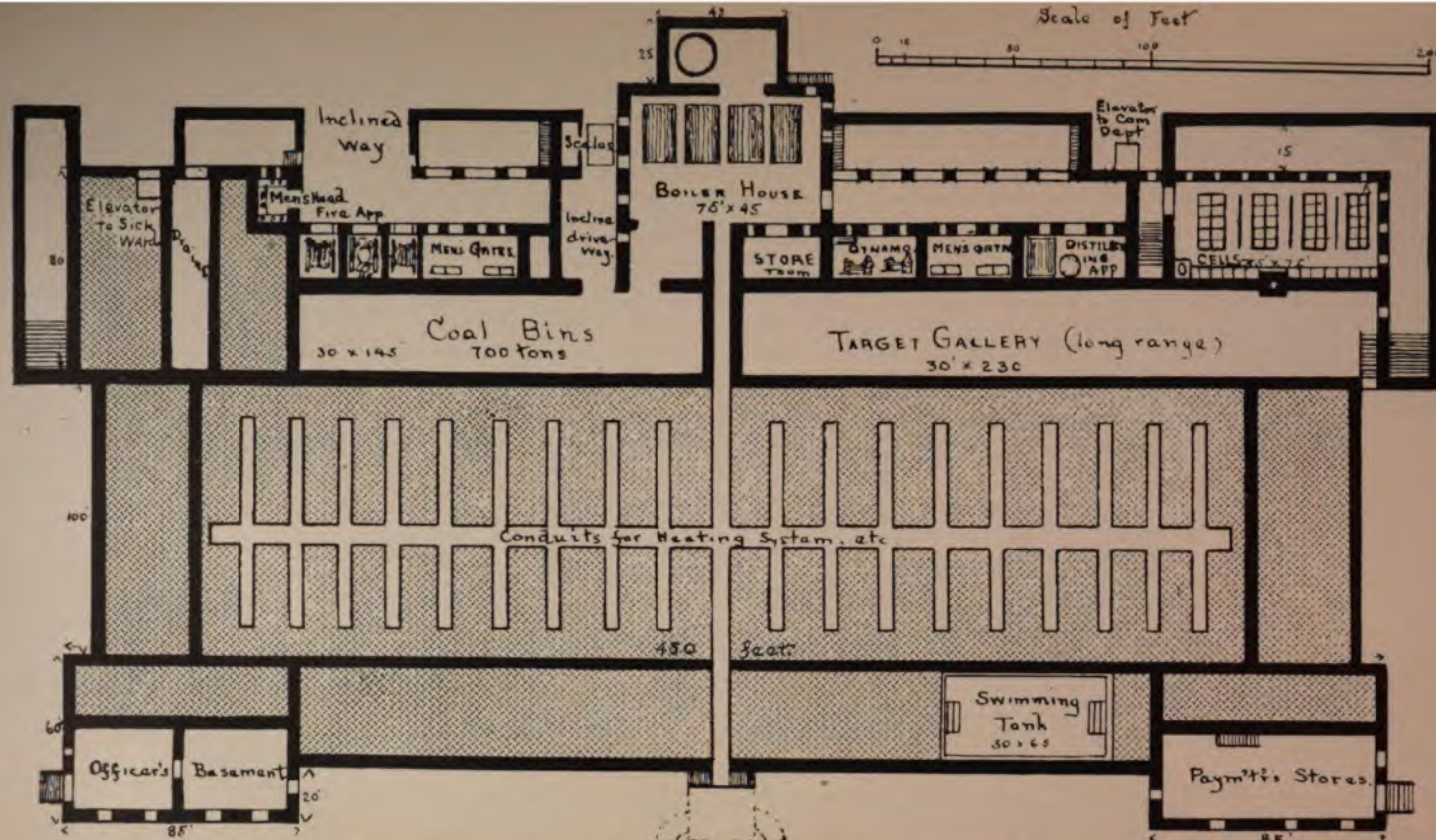
The cards should contain the continuous number of the enlistment and name of parent, guardian, or next of kin, and columns showing the date of each promotion from class to class, with marks, conduct record, and ratings. This is practically an enlistment record on a card, but has greater scope, and is necessary on account of the impossibility of constant reference to the unwieldy enlistment records in such large numbers. These cards will show in the long run the results of the system, the most successful station, and may suggest needed changes. In no other way can this useful data be acquired and kept by the office of Naval Training.

H. PLAN FOR GENERAL ARRANGEMENT OF STATION.

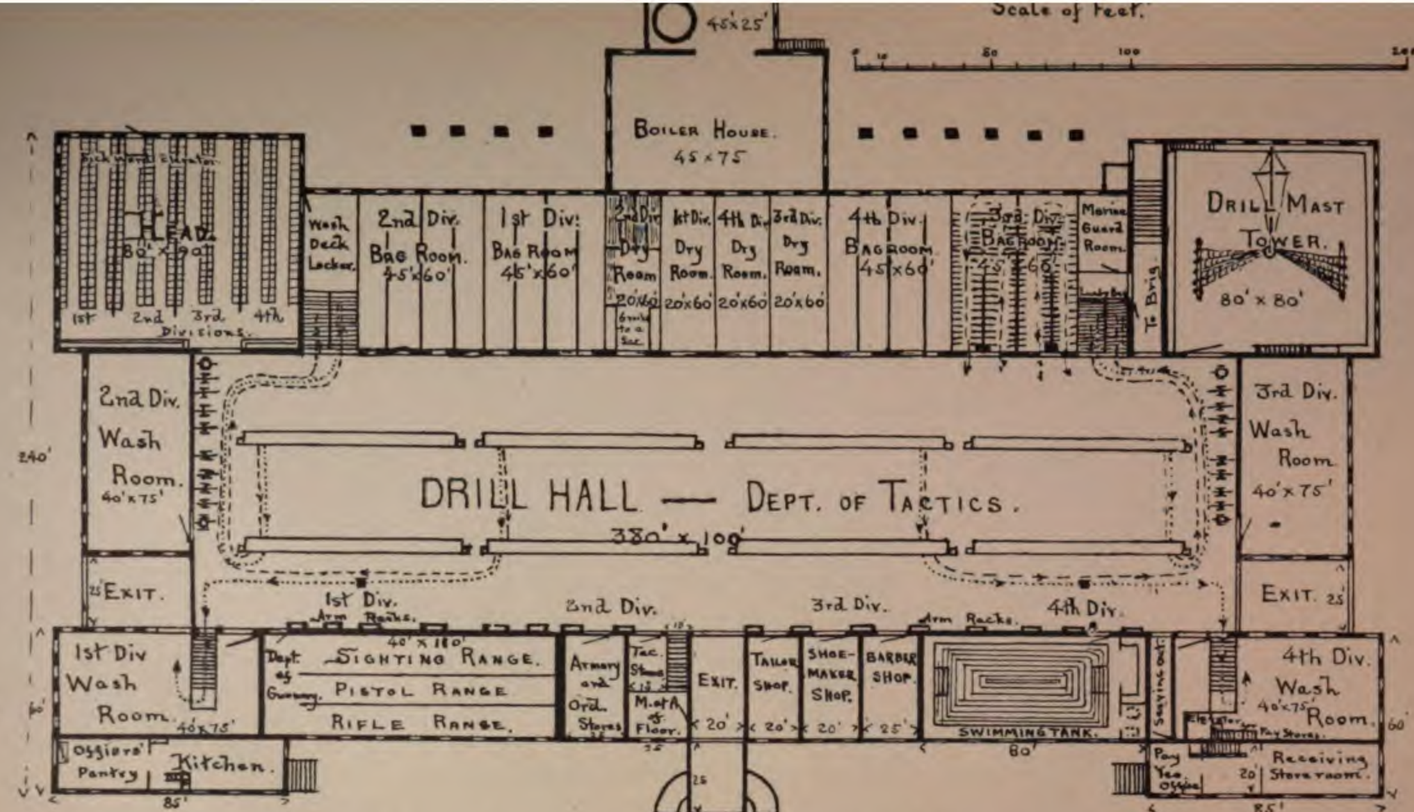
This plan (Plate No. I) will, in connection with the text, explain itself. The peninsula chosen for this illustration was picked out on the chart shown in Plate No. VI on account of its excellent anchorage ground and apparently unoccupied condition. With buildings situated as indicated, with a large parade ground, plenty of room in rear easily acquired if needed, and with a breakwater on edge of shoal for shelter of small steamers and for a boat harbor, this would be an ideal station. The new-

LAN OF UNIT TRAINING STATION.





Tinted areas not to be excavated. General depth of excavation, 8'. Height of top of foundation above ground, 4'.



Routes used in marching to Mess Hall shown by dash lines. - - - -
Routes used in marching to Dormitories shown by dotted lines. . . .

comers have a wharf of their own and a sterilizing plant with annex where they may be quartered without mingling with others until the doctor pronounces it safe. The marine barracks commands the gate. A road around the station for inspection purposes by instructors on bicycles is shown.

K. PLANS OF BARRACKS.

The plans given in Plates II, III, IV and V were worked out from actual experience in the barracks at Newport and constant thought was given these problems at that time. Many of the details were worked out on the spot and every phase of the daily life of a recruit has been considered. The defects of the barracks at Newport are believed to have been eliminated and a number of new and useful features added.

The proposed barracks is to be complete in itself, 240 feet by 480 feet, being built around a central drill hall, 100 feet by 380 feet. Of course such a building should be as nearly fire-proof as possible with water-tight floors.

This drill hall is to have its floor heated by pipes in conduits beneath and is to have a glass roof with sufficient openings for ventilation.

There is to be a basement, partially excavated for the boiler house, heating system, distiller, dynamo room, pump room, fire apparatus house, firemen's quarters, and for stowage of coal. This is all in the rear part of the building and cut off entirely from it save by one door for necessary communication, the rest of the rooms opening out doors. Here are also located the cells for prisoners and a space for a long target gallery if this is found necessary.

The first (or ground) floor is the drill hall floor and has grouped conveniently around it the wash rooms, dry rooms, and bag rooms for each division so arranged that the different streams of recruits passing to and fro do not cross. There are also on this floor the drill mast tower, the water closets, the target range, the swimming tank, barber, tailor and shoemaker shops, armory and storerooms, the small store and clothing serving-out place, and the master-at-arms' rooms and marine guard room.

The bag rooms are to be arranged by companies with a box for the keeper of each from which he can unlock any single

bag called for without opening the others. A system of this sort will save an immense amount of trouble with regard to petty thefts, and much facilitate the serving out and stowing of bags, a very important item with 1000 recruits, as was found to our sorrow the day the battalion marched into the new barracks at Newport when hours were spent in stowing and serving out bags from badly designed bag rooms.

There is an exit to the front from the drill hall floor and one at each end 20 to 25 feet wide, large enough to march the battalion out of in column of fours. Stairs lead direct from each corner of the building to the dormitories and also double stairs at each end to the mess hall, enabling all divisions to march to meals or hammocks simultaneously, a great saving in time, and decidedly safer in case of fire.

The next floor is the office floor with the drill mast tower at one rear corner, the medical department at the other, and the mess hall between. The galley and bakery are in rear with serving-out windows for each division. A commissary office, storerooms, refrigerator rooms, sinks for each division, and an instructors' mess room are also provided. The recruits are to be seated by divisions, a section at a table. This is a reform long desired and does away with the constant changes in the seating arrangement, while enabling the sections if reduced in size to close in along their own tables towards the serving places.

The postoffice is also on this side of the building and a hanging gallery should run around and across the drill hall for the use of officers.

The drill mast tower has inside stairs and enough galleries for observation and instruction, as well as a sail and gear storeroom.

The medical department is easy of access, is not a thoroughfare, and has offices for the surgeon and dentist, a large dispensary, storerooms, rooms for medical attendants, a sick bay for the sick listers, and a sick ward for the serious cases awaiting transfer to the hospital. An elevator is indicated for removing patients, and others for commissary stores and for the general storekeeper.

The wing of this floor next the tower is taken up by seamanship instruction and model rooms, the other wing being given

up to gunnery instruction and model rooms and an instructors' smoking room. The front of the building is taken up by offices with a corridor in the rear, the paymaster and general storekeeper's office being at one corner and the officers' reception and smoking rooms at the other. Between are the offices for the general inspector of the training service, for the commandant and his clerks, the executive officer and clerks, the officer of the day, the Academic Board, and the heads of departments. Rooms for the reception of visitors to the recruits and for the master-at-arms of the floor are also provided. Stairs lead directly to each dormitory and to the drill hall with special stairs for the officer of the day's office, and there are exits at the front and at the ends of the building.

The upper floor is the dormitory floor, with separate dormitories for each division; these have hammock jackstays about 10 feet apart, allowing generally three ranks of hammocks, with a continuous corridor all around building. These dormitories are to be open on the corridor and closed at ends with swinging doors on corridor. A water closet, sink, and lucky bag is provided for each division, and instructors' rooms are placed at each end of each division so those on duty will be near at hand to preserve order. The inner windows of this floor are to be above the glass roof of the drill hall and numerous skylights for additional ventilation should be provided.

The drill mast tower continues through this floor, the remainder of the rear side of the building being taken up with school rooms, library, fencing rooms, rigging lofts, and an extra dormitory for overflow or for use of the restricted squad.

The building should be surrounded by level concrete to prevent water and dirt getting in, and for formations, drills, etc.

L. PROPOSED SITES.

If searching the whole Atlantic Coast line from Maine to Florida for a suitable location for a naval training station, it is hard to see how the claims of Chesapeake Bay can be passed over, or how the several unequalled natural harbors in this great sheet of water can be neglected.

With also a climate allowing outdoor work well into the winter months and early in the spring; with a fine market country all around; and within easy distance of Washington,

Baltimore, Annapolis, and Norfolk, it is hard to imagine any more ideal site for this purpose than several to be found here.

Annapolis has been admitted to be the best place for the Naval Academy, but several better harbors and more advantageous sites exist along the shores of this fine bay. Among these the following may be found:

1. The Patuxent River, Md.
2. Yorktown, Va.
3. St. Mary's, Md.
4. Some point on Eastern Bay.

These will suffice though others can be found at least equal in situation and far superior in climate to the bleak location of the New England and Lake regions.

Of those named the Patuxent River entrance is, for many reasons, the best. The water is deep and clean, the land is high. The local doctors claim that malaria is a rare disease; it is certainly as healthy as Annapolis.

There are a number of points near the entrance which would be suitable, but for illustration, and on account of its commanding position, Town Point has been selected in the plate.

The harbor has a clear, well-lighted entrance with few shoals, is easy of access day or night, and is safe in all weathers, with fine holding ground.

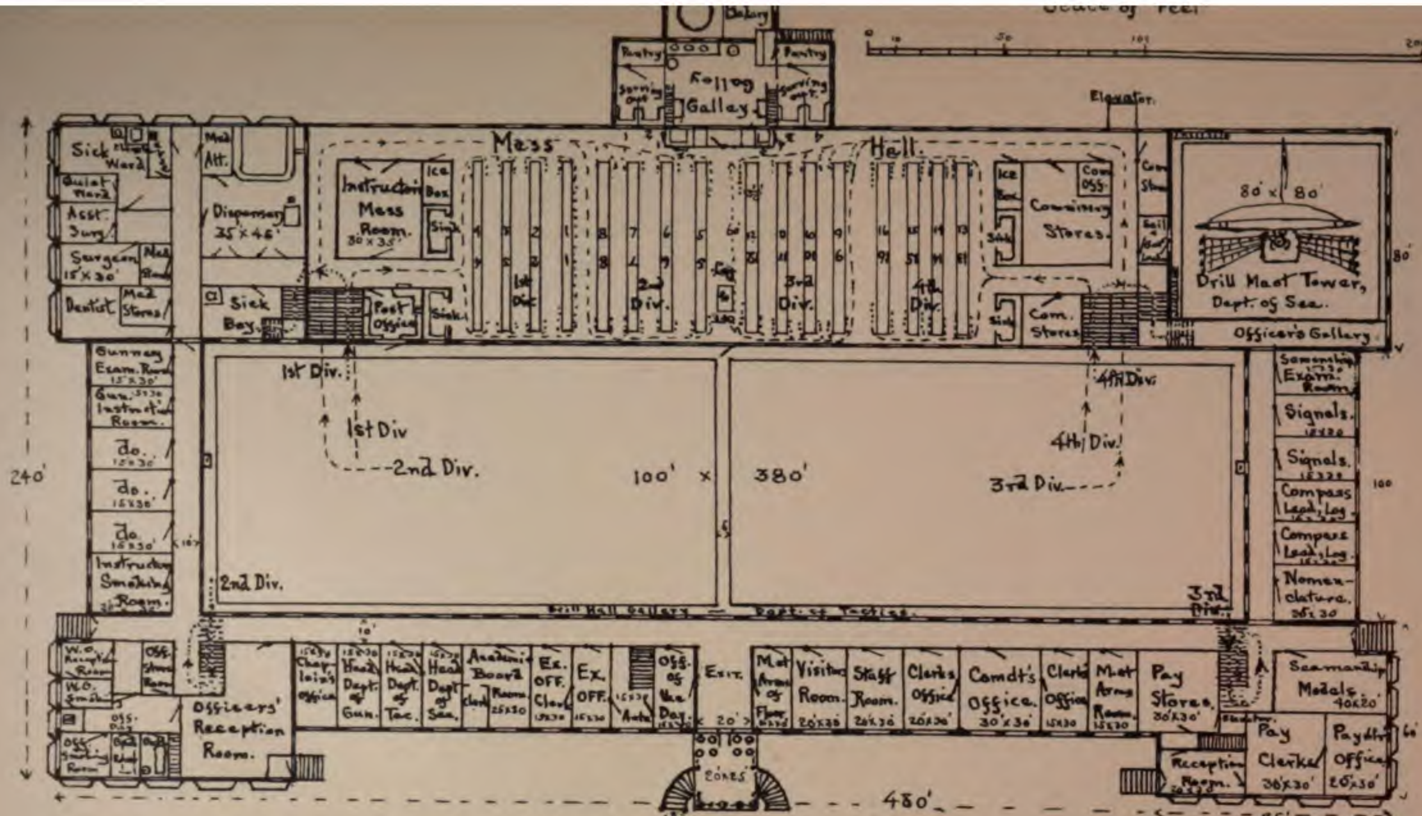
The outer harbor is almost landlocked, the inner one quite so, with over 100 feet of water in much of it, and deep water for miles up the river.

The south side of the outer harbor is steep-to, and bold cliffs surround the whole, rising 30 to 70 feet with level plains beyond. Just outside the harbor entrance, within 3 or 4 miles of the moorings, the west coast of the bay extends for miles north and south clear of shoals. Here a small vessel can safely stand close in toward the beach with 5 miles to run across the bay to the shoals on the other side. Even should she strike, the bottom is sandy, there are no rocks, and little or no damage would probably result, while a safe anchorage in almost any weather can be made anywhere in the bay.

No better cruising ground for the sailing auxiliaries could be found, and there is plenty of room for the target practice of the gunnery craft.

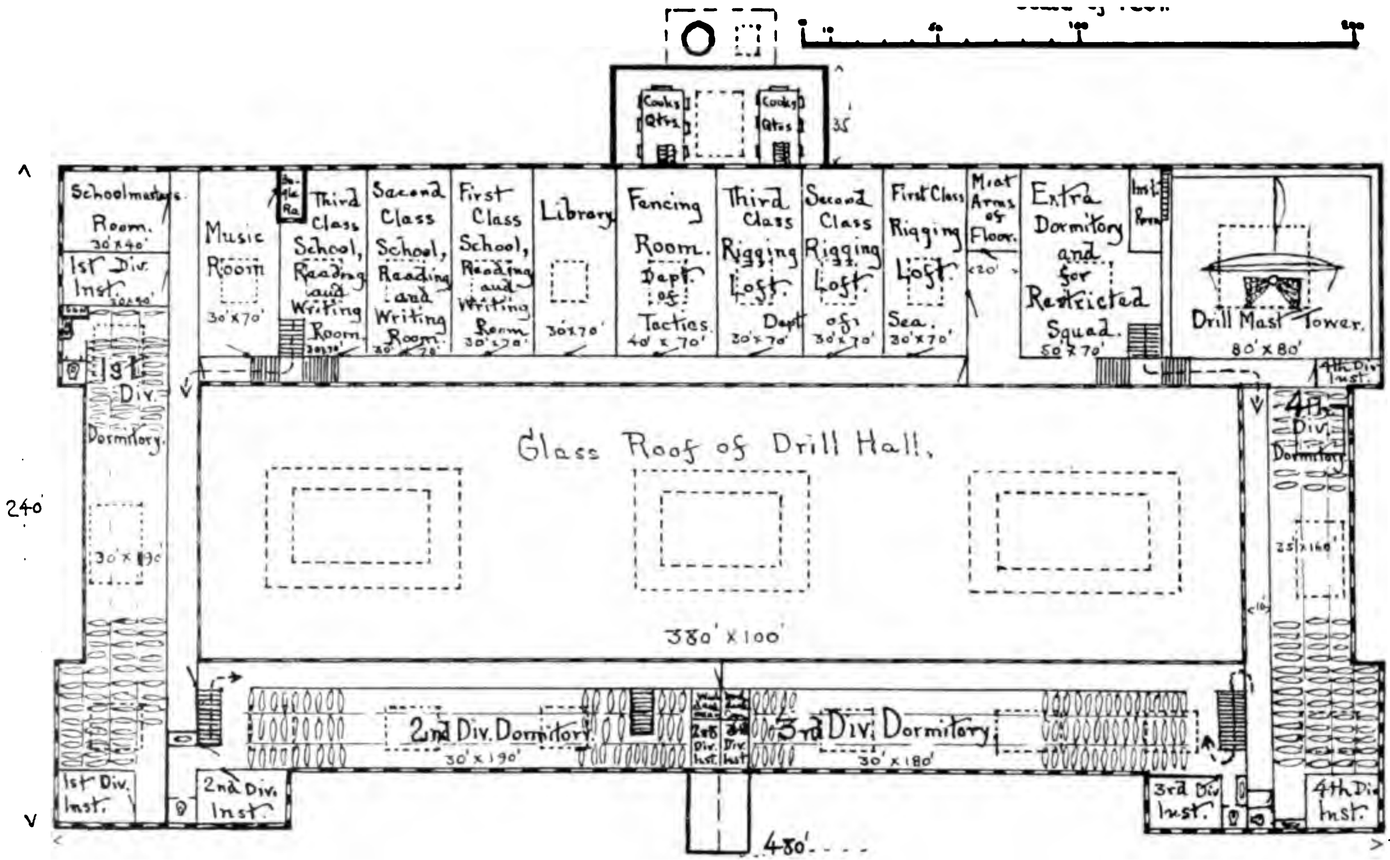
A railroad will soon give close connection with Washington

PLATE IV.



Routes used in marching to Mess Hall shown by dash lines. - - - -
Routes used in marching to Dormitories shown by dotted lines. . . .

PLATE V.



Positions of Ventilators and Skylights shown by dash lines. - - - -


PROPOSED SITE FOR UNIT STATION,
PATUXENT RIVER, MD.
COPIED FROM C.S. Chart 386.
Proposed Site in RED.
Other good sites in Chesapeake on sub chart in red.
Drum Pt.
Cedar Pt.
Scale of Nautical Miles.
Soundings in Fathoms.
Chesapeake Bay.
Miles.
Baltimore
Suitable locations shown in Red.
Railroads ---- " thus
" (proposed) " "
Steamer Lines " "

and Baltimore; a steamer line now makes bi-weekly trips to and from the latter place.

Here is indeed an ideal site; there is no need for further search for the place for another station. We will soon be compelled to build more training stations, here ready to our hands is one of the places. Even while this is being written pneumonia is rioting at Newport, but this is not a surprise to those who know its exposed position, its damp fogs, and piercing winds.

And now, by way of a last word. With our "Monroe Doctrine" to uphold, it becomes day by day more apparent that we must have a great and powerful navy—we of the cloth know it; the people of this great country realize it at last; Congress has shown that it recognizes the fact and to-day stands ready to give what is proved to be necessary. Let us lay before them the proposition that while a hundred millions will be required to build even a moderately strong navy, only two or three (the price of half a ship) will build stations and auxiliaries enough to train the real bulwark of the nation—"the man behind the gun" —without him ships will be useless.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY.

MOTTO: "*The bed-rock of a naval service is organisation.*" *

By LIEUTENANT C. L. HUSSEY, U. S. Navy.

"Historically good men with poor ships are better than poor men with good ships; over and over again the French Revolution taught this lesson, which our own age, with its rage for the last new thing in material improvement, has largely dropped out of memory." † The problem that confronts us is not the manning of poor ships, but the providing of crews for men-of-war, which through liberal appropriations of Congress and well directed efforts of American naval constructors, mechanical engineers, and ordnance experts, compare favorably with any afloat. But "good ships and good guns are simply good weapons, and the best weapons are useless save in the hands of men who know how to fight them." ‡ While it is generally conceded that naval battles will continue to be won by the superiority of the men behind the guns, the enlisted personnel has not awakened the interest in the service that it deserves nor attracted as much attention as some branches of the material. The popular belief in the facility with which a large naval force can be mobilized is unfortunate, and the feeling of security and confidence in the navy, on account of easily won victories in the Spanish war, is unwarranted.

* Rear Admiral Belknap.

† Mahan.

‡ President's message to Congress, 1901.

"Preparedness for a naval war consists not so much in ships . . . as to have trained men in adequate numbers fit to go on board at once and use the material. Fit by familiarity not only with the special instruments but with a manner of life" * In a population of eighty millions such preparedness ought to be easily accomplished as far as numbers are concerned. As to fitness much depends upon the standards adopted. Recent experiences in the expansion of the navy show that the most difficult task before us is the training of the enlisted force so that the vessels under construction may have efficient crews.

The discussion in the NAVAL INSTITUTE of the proper type of ship for the training of recruits afloat indicates a healthful general interest in the early education of apprentices and landsmen. Undoubtedly the character of the ship in which a recruit does his first duty afloat will have a marked influence upon his general development, but the *system* under which the training is carried on will have far greater weight in determining his usefulness to the naval service. It is to be regretted that this question of type of ships did not involve a discussion of the training of the entire enlisted personnel.

In his annual message to Congress, December, 1901, the President stated with reference to the needs of the navy that "the men must be trained and drilled under a thorough and well planned system of progressive instruction while the recruiting must be carried on with still greater vigor." During the past year success has attended the measures adopted to obtain the recruits, and some branches of the training have received much attention, but a *general system* of progressive instruction such as indicated, has received little or no consideration. The necessity of such a system is becoming more evident daily, but the devising of one has not been undertaken, probably on account of the vast amount of labor involved which must be futile without official recognition.

During the past four years the writer has had exceptional opportunities to note the needs of the service with regard to training while on duty at the Newport training station and in the Topeka, Alliance and Hartford, and during the mobilization of 1900 in the Massachusetts with a deck force

* Mahan.

largely composed of recruits. With such frequent change of duty one is impressed with the general lack of uniformity and the necessity of systematic training. A study of service conditions shows that many of the defects are of long standing and nearly all have been commented upon frequently in unmistakable terms. There is little that is new in what follows. Many of the propositions which were thought to have an element of originality seem to have been under discussion for years, and if the excellent measures advocated from time to time had been carried out there would be little occasion for this article.

No criticism of individuals or ships is intended in what follows. This review of present conditions, future demands, and suggestions for improvements is submitted for consideration with no other object than that it may be the initial step towards the adoption of a general system of naval training.

Present Conditions.

The Navy Regulations make ample provision in a *general* way for the recruiting, training, and treatment of the enlisted force. Strictly followed and fully carried out these provisions of the Regulations would insure healthy, contented, well trained American crews for our ships. That this does not always obtain is due to various causes, nearly all of which have their origin in the gradual changes of condition of personnel and material during the last ten or twelve years. The machinery of naval administration has not developed in proportion and facility with the increased responsibilities and duties attending the expansion of the enlisted force which has more than trebled in the last decade. The customs and traditions of the service, formerly the guides for carrying out the details of organization and training, insured unity of action in a smaller navy made up of ships of similar types. To present conditions and needs of the service many of these customs and traditions no longer apply, and others are forgotten.

In the absence of any regularly adopted system for the general training of modern men-of-war's men, there has been much diversity of opinion not only as to methods but as to desired results. In each of the various types of vessels there is a tendency to develop the knowledge along special lines without

regard to its usefulness in the general service. Specializing before qualifying generally is producing a class of petty officers most competent in their respective branches but lacking the resources of seamen readily recognized by Napoleon; he always kept a few hundred seafaring men in his headquarters guard, and paid the highest tribute to their general usefulness.

The present satisfactory condition of the various schools for the early training of recruits—apprentices and landsmen—is evidence of what can be accomplished in the face of much outside opposition by officers interested in the work and receiving the cordial support of the Department. A casual inspection of the training stations will give convincing proof of the facility with which the early training can be carried on in barracks and the high state of efficiency reached in the limited time allowed. Many of the training ships are also doing excellent work, considering their crowded condition, and the indifferent character of their regular crews. But the present system of training afloat is not economical in point of time or expense, and does not supply a sufficient number of recruits qualified for transfer for the general service.

The impression that this early training accomplishes little is due to lack of proper understanding and appreciation of the conditions under which it takes place. The character and scope of the work done are by no means uniform, as the requirements of the service frequently demand the transfer of men from training stations and training ships before they are qualified to leave. At present the time allowed for this part of the training is too limited to obtain the results expected by some. It is too much to expect that a boy of sixteen of average intelligence can be made a thorough seaman, gunnery expert, and signalman in a year, the average time from the date of enlistment to transfer to the general service.

The establishment of courses of a special nature, while leaving much to be desired in the way of co-operation, is sending many well trained men out in the service, as evidence of their efficiency. At these schools and in other parts of the service there are many officers zealous and untiring in their individual efforts to improve the condition of the personnel. Their experience has resulted in the development, in individual ships and at stations, of many excellent methods which if generally known

would be valuable to the whole service, but oftentimes are of no permanent value through change of personnel.

The Navy Regulations provide that instruction in training ships and in the general service shall be progressive and conform to the system adopted at training stations. But the character and extent of the work done there and the methods employed is not generally known; there is no recognized system; and the instruction is often of the nature of the most convenient, rather than the most useful; time is wasted on obsolete and useless drills which were an essential part of the training in the past; more time is lost through lack of preparation in advance of the drill period; interest lags over frequent repetitions of useless details while important subjects are not touched upon; there is too much drill and too little practice; tedious lectures are given while advantage is not taken of the facilities for practical instruction out of consideration of the condition of equipments which become antiquated before they show evidence of service,—another instance of greater regard for the condition of material than of personnel. For want of proper supervision there is lack of uniformity of instruction, not only in different ships but also in different divisions of the same ship.

The prominent part taken by the navy in the Spanish war and the popular interest it awakened, especially in the interior, has resulted in the recruiting of large numbers of young Americans of sterling qualifications, who show much interest and zeal at the start. It is to be expected that the unnatural life may prove distasteful to some, but that it fails to offer sufficient inducements to make a larger percentage of these recruits remain in the service is a matter deserving careful consideration. The average length of service of the enlisted men at present is about three years. It is this short service that is the root of the trouble of efficient training.

The most alarming feature of the present situation is the general apathy. The achievements in large commercial enterprises of an international character have resulted in a popular belief that, in case war becomes inevitable, means for successful preparation will be found; no account is taken of the rapid progress made in foreign navies, and the practical knowledge they are acquiring daily. Such a course means disaster. What is needed is sustained interest of a practical character.

Future Demands.

The foreign policy to which the United States seems committed makes a moderate sized navy a necessity; the actual size will depend in some degree upon the effective naval forces abroad. While the naval powers continue to make large additions to their fleets the expansion of our own navy will probably go on, as the largely increased naval appropriations meet with popular approval.

The recommendation of the Chief of the Bureau of Navigation for an increase of 3000 men brings the total enlisted force up to 31,000—the number needed to man the vessels ready for service by 1904. Further increase is necessary to provide crews for vessels contemplated and it should be authorized along with the new construction.

To have a safe working basis, in considering the facilities for training, 40,000 has been regarded as the aggregate enlisted force. To keep up that number at the present rate of loss, 1200 recruits monthly will be required. It is the training of these 14,400 recruits yearly and improving the work done in the general service that demands our serious consideration.

Points to be Considered in Developing System.

Assuming that present conditions and future demands necessitate radical changes and improvements in methods of training there are certain questions affecting the general character and efficiency of the work that must be settled at the outset, and a definite policy outlined upon which to base further development of the system. In deciding these questions the future effect as well as the immediate advantage of the measures adopted should be considered; the general good of the whole service and ultimate fighting efficiency should be the guiding principles.

What are to be the standards of efficiency? Such as to insure success in battle with equal numbers, and nothing short of honorable defeat by a superior force. Ship for ship and man for man we must have no superiors. An investigation of conditions abroad shows that every naval power is making strenuous efforts towards improvement of personnel. To attain the desired state of efficiency in our own service the best class of

recruits must be obtained, the facilities for training improved, and greater average length of service secured.

RECRUITS FOR THE SEAMAN CLASS.

There has always been much opposition to the apprentice system since its foundation in 1837; acts of Congress authorizing it were repealed twice, the present law dating from 1875. The disfavor with which it has had to contend in the service has been a serious hindrance to obtaining the best results, and difference of opinion as to policy has been a constant obstruction to legislation providing the necessary facilities for good work.

The success attending the recruiting and training of landsmen has brought the two means of recruiting the seaman class in comparison with a growing sentiment in favor of landsmen for training. Several officers who are close observers and have had experience recently in training both landsmen and apprentices are strongly in favor of abolishing the entire apprentice system, believing that results already obtained show the superiority of the older recruits. But there can be no question as to the more lasting effects of military instinct and spirit cultivated before maturity; in the British navy, where conditions of the enlisted personnel more closely resemble our own, the seaman class is recruited entirely by enlistments between the ages of 15¼ and 18.

The alleged defects of the apprentice system are greater cost and labor of training, little practical service rendered during the greater part of the first enlistment, and the failure of any considerable number of apprentices to re-enlist. In view of the present condition of the enlisted force these are grave faults. But future warrant officers and petty officers must have had the distinct advantage of training while young, so instead of abandoning the best source of recruiting, remedy the principal defect by raising the minimum age of apprentices to 16, making the corresponding physical requirements so high as to effectually prevent enlistments under that age.

For convenience in training, divide the recruits into two classes according to age—apprentices from 16 to 19, and landsmen from 19 to 25. Make the pay of apprentices, third class,

$12.00 per month, increasing it to $16.00 when they qualify as apprentices, second class, about six months after enlistment, and give the pay of an ordinary seaman upon transfer to the general service.

AMOUNT OF TIME DEVOTED TO PRELIMINARY TRAINING.

How much time should be devoted to training of recruits preliminary to their transfer to general service? In the future as in the past expediency will determine to a great extent the time to be given to this part of the training. But in a well developed system the transfer of recruits to fighting ships should not be made until they are so well qualified as to need no further elementary drill and instruction that will interfere materially with the general training required to keep the ship up to the highest state of fighting efficiency. Furthermore due regard should be paid to the greater facility with which a number of the drills now included in a ship's routine can be carried out on shore.

To meet the immediate demands of the service it may seem advisable to limit this early training to six months or even three months in order to man new ships and make available for other duty officers engaged in this preliminary training. Six months instead of one year's preliminary training with the same facilities, explained later on, will release about 46 line officers, 65 warrant officers, 629 petty officers and men directly engaged in the work of training, and will add 4500 recruits to the number available to man ships. But in the end it is not believed that the additional number of ships will compensate for the decreased efficiency in every ship, and the effective fighting power of the whole navy will suffer as a result. A safer plan is to increase the number of ships in commission only as efficient crews are provided, using every possible means to hasten the training.

Assuming that sailing vessels and gunnery ships will be regularly assigned to all training stations in the future, and that transfers will be made directly from these stations to the general service, a recruit during this early training should be taught how to take care of his clothing, pull a good oar, swim, and wigwag; he should have had the training in gunnery prescribed

for the "preliminary class" in both small arms and great guns; should know enough about ordnance to use small arms and rapid fire guns intelligently at drills; should be proficient in infantry, artillery, and gymnastics; and should have a practical knowledge of the lead, log, and compass, and such knowledge of sail and spar seamanship as may be deemed necessary for his general development and future usefulness. It is useless to attempt to cram all this into a recruit inside of six months, and a year can be employed profitably in providing a good foundation for advanced training. In the British navy sixteen months are allotted to this part of the work.

Facilities.

The large increase in the number of recruits makes more extended facilities for training necessary. The system aims at bringing to everyone the things he ought to know in such a way and under such conditions as to be most readily understood. The quickest and most efficient means should be adopted without too much regard for expense. The present emergency is not a proper time to practice great economy. If a navy is needed the ships should be efficiently manned whatever the cost. It will be false economy to provide cheap crews for expensive ships—crews that will not get the full efficiency out of equipment provided at great expense. Naval powers should be rated according to the number of well trained men rather than the number of first-class ships.

Without entering into a discussion of the best type of ship for the early training afloat, the writer believes that he is in accord with the prevailing sentiment of the service in recommending the substitution of sailing brigs and gunnery vessels, attached to the training stations, to do the work of the present cruising training ships. By such a change two great advantages are gained—progressive training up to time of transfer to general service will be insured, and serious offenses can be properly dealt with, the offenders being dismissed before they have an opportunity to corrupt others.

The brigs should be of 500 tons displacement carrying 100 recruits, and the gunnery vessels should be large enough to accommodate 50 recruits at a time. The following is sug-

gested as the personnel of the regular complements of these vessels:

SAILING BRIGS.	GUNNERY VESSELS.
1 lieutenant, commanding.	1 lieutenant, commanding.
1 midshipman.	1 gunner.
1 medical officer.	1 chief gunner's mate.
2 boatswains.	1 master-at-arms.
1 chief master-at-arms.	1 gunner's mate.
1 chief boatswain's mate.	1 boatswain's mate.
2 masters-at-arms.	1 quartermaster.
4 boatswain's mates.	2 ship's cooks.
2 quartermasters.	1 mess attendant.
1 sailmaker's mate.	1 hospital steward.
2 ship's cooks.	1 chief machinist.
1 officer's cook.	1 oiler.
2 mess attendants.	1 fireman, 1st class.
1 yeoman.	1 coal passer.
1 hospital apprentice.	
1 carpenter's mate.	

To avoid congestion, facilitate progressive instruction, and provide for supplying the regular service with men at frequent intervals, recruits should be divided into four classes and assigned to the various branches of work as follows:

	On Shore.	Sailing Brig.	Gunboat.
4th Class	3 months	....	....
3rd Class	2 months	1 month	....
2nd Class	2 months	1 month	....
1st Class	1 month	1 month	1 month
Total	8 months	3 months	1 month

The time allotted to training in the sailing brigs is distributed over the year's course in order that the younger recruits may have the advantage of being associated with the more advanced. Gunnery training afloat is confined to recruits of the first class, who will have made sufficient general progress to fit them for this most important work.

Experience has shown that 1200 to 1500 recruits are about as many as can be trained to advantage under a single command on shore. Assuming that they will receive a year's train-

ing before transfer to the general service, it becomes necessary to establish several new training stations to provide for 9000 recruits. The ideal location for a training station would fulfill the following requirements: be healthful; have a climate permitting drills of all kinds throughout the year; have facilities for ranges for target practice on shore; a sheet of water close at hand where great gun target practice may be conducted generally without interruption; be easy of access to training ships under sail, and afford a safe anchorage for small craft; have facilities for boat exercises under oars and under sails; have a large drill ground for infantry and artillery which can also be used for field sports; and be near a large city.

The following locations are regarded as the places best suited for training stations: Newport, Chesapeake Bay near Hampton Roads, Port Royal, Pensacola, San Francisco, San Diego, and Puget Sound near Seattle. San Diego fulfils nearly every requirement, and it being especially adapted to the training of apprentices, the station at San Francisco should be used for training older recruits only. It is unfortunate that a desirable location cannot be secured in the vicinity of New York, as that is the proper place for a large station.

Better results are obtained in training by having recruits of nearly the same age together. Estimating that about 40 per cent will be enlisted as apprentices—between the ages of 16 and 18—it is suggested that recruits be apportioned to the stations as follows:

Apprentice Training Stations.	Whole No.	In Barracks.	In Sailing Brigs.	In Gunboats.
Newport, R. I.	1200	800	300	100
San Diego, Cal.	1200	800	300	100
Port Royal, S. C.	600	400	150	50
Puget Sound, Wash.	600	400	150	50
Total	3600	2400	900	300

Landsmen Training Stations.	Whole No.	In Barracks.	In Sailing Brigs.	In Gunboats.
Chesapeake Bay	1800	1200	450	150
Pensacola, Fla.	1200	800	300	100
Lakes	1200	800	300	100
San Francisco, Cal.	1200	800	300	100
Total	5400	3600	1350	450

Personnel for Training Recruits.

Attention to details and careful supervision are essential to efficient training. At present executive officers of large stations have more work than they can attend to with advantage, and an additional officer, the next in rank, should be regularly assigned as inspector of all training and ordnance officer. The number of officers and petty officers engaged in training should be in a direct ratio to the number of recruits. The following is suggested as the personnel for training on shore at each station:

GENERAL DUTIES.	EACH 200 RECRUITS ON SHORE.
1 commandant.	1 lieutenant.
1 executive.	1 boatswain.
1 inspector of training.	1 gunner.
2 medical officers.	1 chief master-at-arms.
1 paymaster.	1 chief gunner's mate.
1 chaplain.	1 chief boatswain's mate.
1 boatswain.	1 chief quartermaster.
1 gunner.	1 chief yeoman (schoolmaster).
1 carpenter.	3 masters-at-arms.
1 sailmaker.	3 gunner's mates.
1 pharmacist.	3 boatswain's mates.
1 warrant machinist.	3 quartermasters.
1 chief master-at-arms.	2 ship's cooks.
4 masters-at-arms.	1 hospital apprentice.
1 sailmaker's mate.	
1 commissary steward.	
1 hospital steward.	

With such a detail for training, a division of 200 recruits may be divided into squads of 12 for instruction, and an organization for all drills may be easily perfected. This is not an extravagant number of officers and experienced enlisted men to be engaged in this work as is shown by the following comparison of the requirements of training under the proposed system and in the U. S. S. Hartford:

COMPARISON OF COMPLEMENTS UNDER PROPOSED SYSTEM AND IN U. S. S. HARTFORD.

Disposition.	Commissioned Officers.		Warrant Officers.		Enlisted Force.	
	Line.	Staff.	Line.	Staff.	For Training.	Others.
8 Stations—General Duties	24	32	16	32	56	16a
On Shore—6000 Recruits..	30	..	60	..	480	90
23 Brigs—2250 Recruits...	46c	23	46	..	253	184
15 Gunboats—750 Recruits	15	..	15	..	75	120
Total for 9000 Recruits....	115c	55	137	32	864	410a
U. S. S. Hartford—300 Recruits..................	9	3	4	3	72b	119
At same rate—9000 Recruits	270	90	120	90	2160b	3570

a—Not including gig's or barge's crew, and artificers, mechanics, musicians, and clerical force, the number of whom will depend upon the conditions at each station. Except the boat's crew, these men do not come from the seaman class, and are not a drain upon the fighting force afloat.

b—Including all men in seaman class stationed on deck.

c—Including 23 midshipmen.

Preliminary Training Afloat.

As far as practicable, all training should be under service conditions, and in the preliminary training afloat the life should assimilate that in regular cruising ships. Cruising in blue water was undoubtedly the best way to develop the old-time sailor, but long deep-sea trips do not afford the best facilities for the early training of the modern man-of-war's-man. Night watches make men less ready to undertake an arduous day's work; the inevitable bad weather not only makes systematic training out of the question for days at a time, but it has a most disorganizing effect; so that not even one-half the amount of efficient training can be done at sea that is practicable at anchor or by being underway during the day only. As a rule foreign cruises do not fulfill the object for which they are made. Facilities for sight-seeing and training seldom go together, and the every-day discomforts of a crowded sailing ship more than offset the contentment produced by the amount of shore liberty which it is usually practicable to give. Better results will be obtained by training fewer numbers in smaller ships remaining on our own coast. If these foreign cruises are needed as an inducement for enlisting they should be made in modern ships that reflect credit upon

the flag, with recruits that have had sufficient training to know how to conduct themselves properly on shore.

Sailing ships do not offer the proper facilities for carrying out a progressive course of training in gunnery. In the proposed sailing brigs the training should be limited to seamanship, signals, and instruction of a general character. The gunnery vessel attached to each station is intended to supplement the work in gunnery on shore and at the same time give opportunities for practical instruction in the log, lead, compass, and helm. To reduce the amount of time necessary for their care and cleaning, their outfits should be limited to what is essential for the work each class of vessel is intended to perform.

The brigs attached to each station should cruise in squadron in order to gain the benefit of rivalry. In the vicinity of all the stations indicated there are good cruising grounds where they could anchor at night and during bad weather. The gunnery vessels should get under way daily, Saturdays and Sundays excepted, when the weather and other circumstances permit. The regular complements suggested for both classes of vessels have been reduced to the smallest number practicable for training in order that recruits will be forced to do all manual work. The organization should be carried out to minute details in order to insure uniformity and thoroughness.

In order to put the system into effect immediately there are a number of small craft available for gunnery vessels, some of them being used successfully as such now, and the present training ships, with reduced complements, could be assigned to the stations and made use of until the sailings brigs are constructed.

Receiving Ships.

Receiving ships or barracks will continue to be needed at navy yards to give the necessary accommodation to the enlisted force required to man the commandant's barge and yard tugs, to fire salutes, and for various emergencies such as fires. Their necessity having been established, they naturally become recruiting stations; in order to facilitate filling vacancies in ships at the navy yard at short notice, enlisted men, other than recruits of the seaman class, awaiting transfer to general service should be quartered there.

Some of these navy yards offer good facilities for training,

as the ones at Norfolk and Mare Island, but it is not in the interest of efficient work to have the training of recruits depend in any way upon the constantly changing character and number of men in receiving ships, and landsmen for training should be continued there only until regular training stations can be established.

These receiving stations should be provided with facilities for the first training of all recruits not in the seaman class, and for the profitable employment of the time of the older men awaiting transfer. Before transfer to the general service, recruits should be taught to swim, and all training stations and receiving ships should be provided with swimming tanks for this purpose. With the proposed change in the enlistment record the particular needs of each man will be evident, and can be attended to at this time. In this as in other parts of the training officers must be detailed for its proper supervision and direction.

General Character of the System.

The system outlined in the succeeding pages aims at uniform, thorough, progressive training of all ratings from landsman to chief petty officer; uniformity not only in drills and methods of instruction, but also in privileges, punishments, qualifications for ratings, and organization and internal regulations of ships so as to remove some of the present uncertainties of the career; a system that aims at complete and perfect training but is sufficiently elastic for the varying conditions of the service.

The success of this depends upon more perfect central control; better organization; outlining work for each branch and each step of training and clearly defining results expected; improved methods and facilities for training; better subdivision of work by making every ship in commission a training ship, and, as far as practicable, having everyone on board connected with the training and contributing directly to the fighting efficiency; better development of *esprit de corps;* better development of the petty officer as leader and instructor; establishing standard qualifications for each rating; offering inducements and providing a career that will attract recruits of excellent character and retain them in the service when trained.

While gunnery is recognized as the one great element of

naval efficiency, and the closest attention is given to every detail in training that adds directly to efficient gun-fire, the minor factors, which tend to prepare the personnel for the day of battle, and upon which the highest state of excellence in gunnery depends, are not overlooked.

Personnel of Training Staff.

A system of training having been adopted, the officer, under the Chief of the Bureau of Navigation, who is charged with the direct control of the recruiting and training of the enlisted force, should be selected with some regard for fitness as holds in the case of heads of departments for development of material. It is desirable that he should be an officer in sympathy with the work, with rank commensurate with the responsibility so that his decisions in all matters of detail would be readily accepted as final. To give this office proper standing and make it sought for by officers of ability, the head of this staff should be *ex officio* a member of the General Board. This will keep him in touch with the general needs of the service, and with his knowledge of the condition of the enlisted personnel, he will be a valuable addition to the board. The most competent officer available should be selected, given every possible facility for the work, and held responsible for results obtained. He should have the assistance of a staff sufficiently large for the efficient general direction and supervision of all training.

There should be rotation of officers and petty officers engaged in the early training so as to insure proper regard for the ever changing conditions in the general service, and in fighting ships to secure a better general understanding of the possibilities and limitations of this preliminary training. The regular complements at the shore stations and of training vessels should be made up of experienced men of good character. Under the proposed system of squad instruction a relatively large number of petty officers will be engaged in this early training as, at this time, discipline should be strict and instruction thorough. But it is expected that the petty officers will return to the general service at the end of stated periods much benefited from the training they themselves receive during this time.

In view of the demand for experienced men in the regular service, the number engaged in early training could be con-

siderably reduced by so regulating transfers that at all times one-half of the men under training will have progressed far enough to be an efficient nucleus for the organization, thus making the system continuous. Recruits joining an older organization take their tone from their more experienced comrades, from whom they acquire much practical information that cannot be readily taught or learned otherwise. There are many who question the advisability of thus mixing new and older material, but at the Newport training station it has been tried for several years with excellent results, and when the effect of such mingling is unsatisfactory the training is of doubtful efficiency.

Some chaplains have been quick to recognize their wide field for work in the service and are rendering valuable assistance. From their position they ought to be an important factor in the development of the mental and moral faculties of recruits, and to this end their duties should be more clearly defined. Properly qualified yeomen should be detailed to assist them in their duties and give such instruction in elementary English studies as may seem expedient.

ORGANIZATION.

The whole machinery of the navy dealing with the enlisted personnel should be thoroughly reorganized with clearly defined duties and responsibilities. The formation of a General Board has made this more feasible. The extra labor required to raise the standards in the service will be slight if properly distributed and systematically performed. In making this new division of work fighting efficiency should be the guiding principle.

The Chief of Bureau of Navigation is the natural head of all military training, but his numerous other important duties make it necessary for him to have the assistance of the training staff, already indicated, to take charge of all matters of detail relating to the enlisted force. The staff should have duties similar to the recently appointed inspectors of target practice. They should supervise the allowance of equipment for training; see that drill instructions and material correspond; lay out the work for all branches of training, and select the conditions best suited for every stage of the work, submitting both to commanding officers for suggestions as to desirable changes. They

should be kept informed of all matters relating to condition of training stations and training ships and other facilities which may affect character of work done. The preparation and dissemination of press notices of incidents reflecting credit upon the enlisted men of the navy, or showing the better side of naval life, should be provided for.

It should also be the duty of this staff to study the needs of the service with regard to enlisted personnel. The opinions of officers of experience should be sought upon important subjects, and suggestions for changes in the system should receive careful consideration and be promptly acted upon, thus securing co-operation and encouraging individual efforts for improvement of methods. Advantage should be taken of every opportunity to investigate systems of training in foreign navies. Many valuable lessons have been learned from them in the past, and inquiry into their present strenuous efforts to improve personnel abroad should be made with the same zeal as the study of changes in material.

The general character of efficient organizations for shore stations, sailing brigs, and gunnery vessels was indicated in the discussions of the facilities for the early training.

Fighting efficiency depends directly upon efficient training, and in fighting ships facility for training should be the guiding principle in stationing the crew. As far as practicable everyone should be in the fighting organization and should have duties in connection with the training that will ensure interest in the daily work.

The high state of efficiency of the old navy was due to the completeness of the watch, quarter, and station bill and the traditions and customs of the service which provided for every detail of ship life. In the new navy there have been most efficient organizations in individual ships, but they have been of a widely different character, even in vessels of the same type. All should be carefully studied and the points of excellence of each incorporated in a standard organization to be used in all vessels as far as practicable. Supplying ships, about to be commissioned, with a draft of an organization, that has been successfully tried in vessels of the same class, will relieve executive officers of the necessity of working out the same problem independently, requiring much time when it cannot be well spared.

The adoption of such a standard station bill and a uniform system of general alarms and bugle calls will reduce to a great extent the confusion incidental to placing a ship in commission and the general discontent and wholesale desertions which result usually.

The "quadrantal system of organization" successfully tried in the Oregon is adapted to any type of vessel from a gunboat to a battleship; it was found to work very well in a sailing training ship. In that system the powder division was made up of the idlers as is customary in all ships, but there was no navigator's division. The boatswain's mates, quartermasters, signal men, buglers, and men required to handle the vessel at general quarters under way were known as the "navigator's detail," but were regularly assigned to the gun divisions, and attended all divisional drills and instruction. A seaman standing quartermaster's watch made the duty easier so that the quartermasters could take part in the drills without being overworked. They were of much assistance in the instruction of the lower ratings, and by keeping up in the drills and exercises their sphere of general usefulness was enlarged. Such an arrangement is particularly adapted to the new course of training in gunnery. It should be adopted in all vessels as the navigator is able to give his division little personal attention during the drill periods, and most promising petty officers stationed in the navigator's division are apt to stagnate.

With a well drilled, well disciplined crew the care of the ship should give little trouble, and where efficiency in training must be sacrificed to keep a ship in proper condition either the vessel is poorly adapted to the work or there is lack of proper organization.

EQUIPMENT.

The equipment for training should afford every facility for making drills and instruction interesting and practical and for obtaining best results for time employed. Training stations and training ships should be so fitted out that they may be made comfortable and attractive, and easily kept clean. The best equipment is none too good to give the recruit a correct idea of things being ship-shape when his character is forming. At the outset his surroundings should be such as to make him

proud of his position. Results obtained will justify the additional expense incurred.

The many excellent schemes to illustrate and facilitate instruction that have been devised in various branches of the service should be made known generally, and the necessary outfits or material to make them should be furnished. Complete sets of professional books, and elementary school books, should be supplied and made easily available to the crew. Every possible facility should be afforded the enlisted man to improve his professional standing. Provision should be made also for furnishing suitable athletic outfits and such other articles as tend to promote health and contentment. There should be an additional allowance of such articles of equipment as are needed in the systematic instruction of large squads; also of such parts of the ordnance outfit as are frequently used for instructional purposes and are liable to become less efficient for general use.

Such stowage space should be provided for all articles in the equipment for training that they may be easily reached at all times. Their proper use should be unrestricted, and indulgence should be shown in case of accidental injury. Provision should be made for replacing broken or missing articles with the least delay practicable, and the responsibility for its condition should be defined by regulation. Ships fitting out should not be reported ready until this part of her equipment is received.

Recruiting and Enlistments.

Under existing conditions about 14,000 recruits are required yearly. All should be bona fide American citizens, as the retention of aliens in the service will always be regarded as a sign of weakness. The number of American seamen that may be obtained from the merchant marine is so small that it may be disregarded in considering means for recruiting the seaman branch. So eventually this branch of the enlisted force must be made up of men who have received their early training in the service, and their usefulness will depend upon the efficiency of the system under which they are trained.

The good material obtained from districts in the interior shows the wisdom of the establishment of recruiting officers in inland towns instead of restricting them to barge seaports, where the navy was regarded as a convenient asylum for waifs and

questionable characters. Recruits must have healthy minds as well as healthy bodies, and rural districts offer the best field for recruiting young men of this class.

The present system of recruiting is generally regarded as efficient and satisfactory, though in a few cases the large percentage of bad physiques and degenerates in drafts arriving at receiving ships and training stations indicates lack of care or attempt at record making. Reject inferior men who present themselves for enlistment, discharge immediately bad characters in the service, and very soon the increased respectability of the ship's company will not only attract the kind of young men the service needs but will retain many of the desirable ones who fail to re-enlist now. Modifying the present regulations relating to first enlistments in some minor particulars would work to the advantage of the service. As soon as the state of the personnel permits reduce the maximum age of landsmen to 22 so as to have a homogeneous class of recruits, and restrict first enlistments to American citizens; the other qualifications of an applicant should have little weight compared with citizenship if we are to regard "love of country as the soul of a navy." Also restrict first enlistments in seaman branch to the lowest ratings; this will prevent many of the fraudulent re-enlistments of deserters and men discharged with bad records who now succeed in getting back in the service as ordinary seamen or seamen. Men discharged as undesirable should not be allowed under any circumstances to re-enlist.

At the time of enlistment, when every move is full of significance to the recruit, there should be nothing done that later on may seem like breach of faith. The recruiting officer should not only read and explain the meaning of the shipping articles and oath of allegiance, but he should make clear the present condition of ship life and show the future prospects in their true light. Failure to do this has resulted in the recruiting of many young men who rightly feel that they were attracted by false inducements; the great majority of them leave after considerable time and expense in training, and the rest are usually discontented.

Time Available for Routine Drills.

Under the best conditions, three to four hours daily, Saturdays and Sundays excepted, is as much time as can be given

profitably in fighting ships to routine drill and instruction. Bad weather, coaling ship, holidays, and other unavoidable circumstances will reduce the time available so that in a six months' cruise about 300 hours of systematic training will be practicable. This does not include the afternoons weekly usually given to overhauling battery and to care of clothing, nor the time for fire quarters and night general quarters. While small, this amount of time properly employed ought to produce the desired state of efficiency in the course of a few years; if exceeded, in attempting to remedy existing defects, the added drill will be gained at the expense of the general condition of the ship or the contentment of an overworked crew. At best routine drills are irksome, and when men are fatigued interest lags and discontent soon follows.

The amount of time set apart each day for the care and cleaning of the ship should be ample. The details of the systematic performance of this work should receive the same careful attention as any other part of the training.

At shore stations the available time for routine drills and instruction is about six hours. In ships under sail, and recruits standing night watches, only two to three hours' training daily should be given in addition to the usual amount of work in handling sails.

Allotment of Time.

It is not enough that crews of ships should be able to perform their respective duties efficiently. The training should not be regarded as having reached a satisfactory state until every man knows all the duties in the ship performed by men of his rating, and in case of a casualty there is at least one other man prepared to fill the vacancy without materially affecting the fighting efficiency of the organization. Such standard of ship efficiency requires that the scope and relative value of each branch be most carefully considered in order to employ the small amount of available time to the greatest advantage.

There is much diversity of opinion as to the proper character and scope of nearly every branch of the training. What is considered essential by some is regarded as of little importance by others. Whatever the expense or apparent lack of economy of time, the ultimate efficiency of the whole enlisted force should decide these questions.

Following out the principle of not increasing the time devoted to routine training, but employing it better, one of the first and most important steps in laying out the work is to decide upon the necessary and practical, eliminating the obsolete and useless training. Broadsword and pistol drills should be done away with until a satisfactory state of efficiency is reached. Clearing ship for action and general quarters in old style sailing ships seem time wasted.

The character of the training will be influenced by conditions not always similar; but there are certain essentials of a general character that may be taught under all conditions, and these should be taught without fail. The minor points, too, each of little importance by itself, but all contributing to general efficiency, should not be overlooked. It is this completeness which will make a system of great value.

As far as practicable all training should be in regular cruising ships under service conditions. Itineraries should be laid out with a view of insuring favorable conditions for each part of the work. The part that can be done to the greatest advantage under the circumstances, should be continuous until its full scope is reached.

It is evident that the desirable knowledge that the average enlisted man should possess cannot be acquired in the first six months or year of his service. One of the great mistakes has been to attempt to crowd in too much during the brief period of early training. The work should be distributed through the various grades up to chief petty officer, giving the men in each rating only such systematic training as to enable them to perform efficiently all the duties of the rating held, and to prepare them to undertake those of the next higher. This anticipates special training for men in each of the lower ratings as a part of the regular routine, and such individual instruction of petty officers as they may require.

In laying out the work the ground to be covered in each stage should be limited to what can be thoroughly mastered in the time allotted. There is as much danger from attempting too much as too little. Proficiency should be required in every branch, especially during the early training, so that everyone may become accustomed to high standards. Men weary of repetitions of drill and exercises, but usually they show proper inter-

est when anything new is introduced. So it is better to progress less rapidly but thoroughly, rendering only occasional reviews necessary, and leaving something to awaken interest in the future. The work in each general subject should be continuous until a certain degree of proficiency is reached. Drills by weekly routine are adapted only to crews whose training may be said to be finished, where the object of the exercise is to keep up a high state of efficiency already attained.

Instruction and drill do not constitute the entire training. The time allotted for ship work and self-attention, much greater than that given to routine exercises, must be so employed as to familiarize the men with a manner of life that will insure health, contentment, and efficiency afloat. This part of the training has been neglected, and it must receive much attention if the best results are to be obtained. Hours of recreation should be as well marked as drill periods and during leisure time every opportunity should be given the ambitious for self-advancement.

For reasons already stated one year is considered the length of time that should be devoted to training preliminary to transfer to general service. This part of the training should aim at improving the physique, securing contentment, and arousing interest of recruits. Having due regard for the ultimate purpose of a navy—to shoot guns and hit the mark—it is suggested that one-third of the time for routine exercises be devoted to gunnery, one-third to seamanship, the remaining third to signals and training of a general character. The course in each branch should be such as to prepare thoroughly qualified ordinary seamen and apprentices second class for transfer to the general service.

In the general service at least one-half of the time should be devoted to gunnery, one-quarter to seamanship, and the remaining to miscellaneous exercises. This division of time to obtain for all enlisted men of the seaman class, excepting petty officers who hold ratings that require training of a special character.

The seaman gunner's class should be made up of men who, as gunner's mates, have shown practically that they are fitted for the advanced courses at the Torpedo Station and Gun Factory, which should insure all the mechanical training that gunners

and chief gunner's mates require for the efficient care of the battery and ordnance outfit.

Periods.

The time allotted to any part of the training should be actually given at successive periods, drill and instruction alternating when practicable, so as to distribute the physical work. To avoid confusion and facilitate preparation in advance, prearranged schedules should be followed strictly when possible.

The periods should be forty-five minutes long in order that the work may be carried on with snap and interest may not lag. Two periods may be taken together for the drills requiring longer time. Four periods with fifteen minutes' oral instruction or physical drill at evening quarters, is as much as men and officers can stand day after day under the best conditions. In the general service one of the two periods of instruction should be for the special training of petty officers; the other, in ships with well drilled crews, should be restricted to men who are backward. The drill periods should be from 9.35 to 10.20 a. m. and 1.30 to 2.15 p. m., the periods of instruction from 10.45 to 11.30 a. m. and 2.30 to 3.15 p. m. In suggesting such a routine it is assumed that the ship's work will be completed before morning quarters, that the drills and the forenoon instruction will be conducted by divisional officers, while the afternoon instruction will be turned over to petty officers under the general supervision of the divisional officers. By such an arrangement petty officers will get the training and employment so much needed; there will be an incentive to do well to escape the extra period designed to bring the dull and backward up to the standard; and divisional officers, relieved of many petty details of the training, will have more time to devote to more important matters for which there is little opportunity at present.

Methods.

Results in drill and instruction depend as much upon methods employed as upon amount of time given. Under the changed conditions and with the less extended period of training old methods cannot be expected to give the same results as formerly, and others must be devised. Careful study should be made of those tried successfully in different ships and shore sta-

tions, both at home and abroad. The methods best suited to present conditions should be adopted and, in the form of circulars or hand-books, descriptions of them should be issued as aids and guides to all engaged in training.

The character of the men under training must be considered. The greater part have untrained minds and little ability for concentrating the mind. Lectures should be eliminated and every means possible should be adopted to make instruction practical and interesting. At the beginning of each period, attention should be called to the salient points of the exercise and its bearing upon the general training, in order that the men may have a clear understanding at the outset of what they are doing. Grading men for instruction according to rating will be the best means of bringing together those who possess about the same degree of knowledge and aptitude for learning. Squads for instruction should be as small as possible, and not over twenty men each.

In order to secure uniformity, thoroughness, and completeness the whole course of training should be outlined, and the work in each general subject, in each stage, should be given in detail, and issued to the service in hand-books of convenient size for daily use. The various hand-books should also be bound as one volume and issued to ships for use as reference books.

A hand-book which the writer found well adapted to the work in gunnery at the Newport Training Station was in the form of detailed instructions for the petty officers, who did most of the instructing. For the work of each period these instructions were divided into three parts—first, "Preparation," giving the reference books to be consulted, part of drill book to be followed, and equipment to be provided; second, "Outline" of the drill or instruction so as to preclude any doubt of clearness; third, "Questions" that would bring out the important points. The scope was such that it could be covered in about a half hour, the rest of the period being used in asking the questions. This not only shows to what extent the men grasp the meaning of the work but it also develops their thinking powers. All reference books, drill books, regulations, general orders, and equipment that had a bearing on the work were provided for the use of the instructors, and were in constant

use. As a result the apprentices not only made excellent progress, but in the course of a year several of the instructors took advantage of the opportunity afforded, and prepared themselves for the examination for acting gunner, passing it successfully without exception.

Hand-books of the same general character have been used in some foreign navies for many years, and their introduction in our own service has been suggested frequently. The amount of work involved in their preparation is so great that it can only be performed properly by distributing it among a number of officers whose experience in the various branches has fitted them for the work. Hand-books should receive from time to time such modifications as their use has shown to be desirable, or improvement of equipment necessitates.

As far as possible all training should be under service conditions, using service equipment. When this is not practicable, models, plans, drawings, photographs, stereopticons, blackboard sketches and other similar means should be used to make instruction clearer and more interesting.

To get the best results, self-interest, pride, and enthusiasm must be made use of to secure a spirit of emulation between units of individual ships as well as between different ships. Boats' crews, guns' crews, divisions, and companies should all be aroused to good work by competition. But in encouraging this spirit of rivalry care should be taken that apparent superiority is not gained at the expense of thoroughness.

Absence from Drill.

Failures are usually due not to misconceptions but to faulty execution. This applies especially to any system of naval training, where details must be worked out under such varied conditions. In order to secure its success it must be clearly understood that all other work is subordinate to efficient drill and instruction; change of organization or routine should be made, to remove impediments to the work of training. The smart appearance that has always characterized American ships should be sacrificed to efficient training if necessary, but that ought not to be the case, as well drilled crews and well kept ships usually go together.

It is not advantageous to have a considerable part of a mili-

tary organization excused from systematic instruction of a military character, as it must result in stagnation in that part which will reflect discredit upon the whole. Steps should be taken to reduce the untrained force when there is such a tendency to specialize at the expense of general usefulness. In nearly every ship there is a considerable number of the most intelligent petty officers who are excused from all except general drills, presumably on account of the fatiguing nature of their work, or in order to give it their undivided attention. This may be in the interest of the department to which they belong, but it is not always best for the general efficiency of the ship. The deck force available for care and cleaning of the ship is far in excess of the requirements, and a different division of ship work should be made so that masters-at-arms, quartermasters, yeomen, and mechanics may have more routine training.

The recently organized commissary system has relieved the service of one evil, but there is danger of the considerable force, essential to its success, becoming a point of weakness in every ship through lack of training. It would seem a far better plan to detail mess men from the lower ratings month about, the number of men so detailed to be sufficient to do the work properly without being absent from routine drills. Good service will be insured by detailing men regularly as "strikers" just previous to their detail as mess men.

After removing all causes for absence as far as practicable, there still remain many such duties as belong to quartermasters, signalmen, sentries, boat crews and lookouts, that must be performed at all times. For some of these, men belonging to the special class may be used during drill periods. Sentries should be detailed for a period of not over one month, and there should be double crews for steam launches and similar details so as to secure the presence of everyone at quarters at least half of the time; and a minimum number of hours of systematic training quarterly for each class should be prescribed.

Physical Development.

Fighting efficiency depends so much upon the general state of health that the physical development of recruits and physical condition of the whole enlisted force should be the first consideration. Drills in sailing ships will contribute much to the

physical development of recruits considering the length of service in these vessels, but the number so engaged are only a small part of the whole, and other means must be devised to this end. Such drills as infantry and artillery on shore, and boats under oars provide good physical exercise, but the men who need it most, those stationed below, are not usually assigned to boats or companies, and gymnastics on more extended lines than the present physical drill should be adopted for use in the regular cruising ships.

Athletics and sports should receive systematic encouragement. There should be race-boat crews, baseball and football teams in every ship; the supply of athletic goods should be liberal and every opportunity afforded for using them. At all shore stations recreation grounds should be laid out, and the environments should be such as to induce men to spend much of their leisure time at sports and games.

Physical development must be regarded as one of the essential parts of systematic training in order to secure the endurance that will stand the strain of a protracted war. The decline of the general health of our men during the Spanish war may be recalled; also that the reason assigned for the beaching of the Cristobal Colon was the certainty of capture on account of the fire-room force of that vessel in their weakened condition being unable to keep up a full head of steam. Nothing should be left undone that may tend to prepare us for such a test of endurance in the future when even more may depend on the outcome.

Development of Petty Officers.*

The better general development of the petty officer is essential to our future naval efficiency. The present lack of officers must continue for some years, and enlisted men must be detailed for important duties, and in event of war heavy responsibilities might devolve upon them through casualties. While there are some excellent petty officers, and a majority perform their respective duties satisfactorily, as a class they have slight general knowledge and are not the leaders so much needed. The necessity of

* This part of the training was treated at length in an able article by Lieutenant-Commander Fullam in the Naval Institute, September, 1902.

special training for petty officers is generally recognized, but at present divisional officers have little time for their systematic instruction apart from the rest of the division.

The success of any system of naval training and the development of the petty officer are mutually dependent. Thoroughness can only be attained by attention to details which officers of large divisions cannot give without reducing the scope of their work. Much of the preliminary training and detailed instruction should be turned over to competent petty officers under the supervision of divisional officers. This will give officers more time for the individual training of petty officers and for other important matters relating to the improvement of the enlisted personnel.

Intelligence and force are the essential natural qualities that a petty officer should possess. Leadership must be developed by proper employment as squad leader and instructor. While performing these duties they should be closely watched and their mistakes pointed out. Their training in some points should be so clear as not to admit of misunderstanding; they should be made to appreciate the important position which they fill in ship life; the influence of their example in showing to superiors a spirit of subordination and co-operation, while demanding the same of men under their charge. They should be instructed as to the proper manner of giving orders; their responsibility in seeing orders executed quickly and quietly, as a rule directing others rather than doing the work themselves. They should understand that they have a duty in contributing to the contentment of the crew, and should be the leaders in sports and amusements as well as in the work. Every facility should be given petty officers to keep posted and prepare themselves for advancement.

The availability of petty officers as instructors should be considered in arranging watch, quarter, and station bills, so that squads for systematic training may be as small as possible. All petty officers of the seaman branch should be available for this duty, and the division of the ship's work should be such as to insure it. The staff of quartermasters and signalmen, made up of the most intelligent men in the service, should be increased in number so as to make it practicable for them to take a more active part in the training, both as instructors and in receiving

instruction, without adding to the amount of their work. Masters-at-arms are properly included in the seaman class, and they should be in fact what they are in name. The peculiar regard in which they are held enhances their fitness as instructors, and in every ship their number should be considerably increased, taking the places of marines if necessary to prevent overcrowding. The advantage of such an arrangement has been demonstrated in small ships. The development of such a large corps of instructors will make drills and exercises practicable in receiving ships and in other places where little or no training can be given now for want of proper leaders to take charge of the squads.

Development of Esprit de Corps.

"*Esprit de corps* is the moral foundation of the edifice of naval efficiency as well as the inspiration of individual success. Where *esprit de corps* is present the ship is harmonious and well disciplined; where it is absent, discord and inefficiency prevail. Sound organization demands the concurrent efforts of all towards a common end, the good of the service, in other words, the recognition and guidance of *esprit de corps*. The seaman's art is valueless and his education incomplete without it. There is no part of an officer's obligation and duties more vitally essential than the cultivation of this cardinal principle." * Cannot the same be said to apply to the enlisted man, and will not proper development of *esprit de corps* be the means of solving many of the problems concerning the enlisted personnel? The responsibility for such development cannot be fixed as in other branches of the training on account of the diverse elements that enter into it, but the cultivation of this sound, healthy spirit among the men should be provided for.

Two of the chief advantages claimed for sail and spar training are its bearing upon the formation of character and the development of manly qualities. These depend as much upon environments, enforcing discipline, encouraging comradeship, and stimulating ambition by proper recognition of good work, as upon the character of the drills. Conceding that activity aloft produces all the results claimed for it, there is still much

* Captain C. F. Goodrich, U. S. N., Prize Essay, 1898.

left to provide for in the way of developing all the faculties—mental, moral, and physical—while imparting knowledge.

During the early training specific knowledge of a technical nature should not monopolize the attention of recruits. The drills and exercises should be given with a view of inspiring respect for authority and securing alacrity in the performance of duty. Recruits should learn the power of united action, and become accustomed to working with others, under others. It is the cheery "Aye, aye, sir," with prompt and implicit obedience, that is so much needed in the service to-day.

Many of our shortcomings are due to lack of military purpose in training, and there is need of co-operation in every part of the service to improve the general bearing of the men. While not wishing to introduce the question of the advisability of having marine guards on board ship, it is pertinent to call attention to the value of having a large number of the seaman branch engaged in enforcing strict discipline without depending upon another arm of the military service for support. Sentry duty on board ship is a most valuable means of developing in the landsman and apprentice a sense of duty and regard for military authority. Under properly qualified masters-at-arms the performance of such military duty could be made a valuable part of the training. Bulletin boards or other means should be used to insure a clear understanding of such duties, and a strict performance of them required. In order to indicate men on duty, and serve as a badge of authority, a neat belt, to which a bayonet or cutlass may be attached, should be worn by quartermasters and messengers on watch, by coxswains in charge of boats away from the ship, and by all other men while performing military duty.

From the start men should be placed in positions requiring them to take the initiative, demand obedience and accept responsibility. Detail them as acting coxswains, squad leaders at infantry and artillery drills, and place them in charge of working parties. Require them not only to learn the use of articles of equipment but how to take care of them. This part of the training should receive careful supervision and mistakes pointed out with much patience, as recruits are easily discouraged by any show of lack of confidence. The stimulating influence of competition should be made use of whenever possible to awaken

enthusiasm and incite eagerness to be foremost in everything, and every means should be adopted to foster sentiments of loyalty to ship and service. Success inspires the mutual respect and confidence, which insures hearty co-operation of all officers and men; and ship pride is essential to ship efficiency.

GUNNERY.

At last gunnery is receiving the attention it deserves, and the time does not seem distant when a ship's efficiency will be gauged by her record target practice. The instructions recently issued, and improvements under consideration, provide a thorough progressive course in gunnery which affords a proper foundation for the building-up of a general system of training. The work in the other branches should be laid out so that each will contribute as much as possible to improvement of gun-fire and fighting efficiency. This involves consideration of time and conditions most favorable for each stage of the training in gunnery. As far as practicable it should be done in fighting ships under service conditions, but, as pointed out already, shore stations provided with rifle ranges and small gunnery vessels offer special advantages for the training prescribed for the "Preliminary Class" in both small arms and great guns. The greater attention that can be given to more advanced training in gunnery in the general service will more than compensate for the additional time for early training required by such a protracted course of target practice. Gunnery vessels, other than those assigned to shore stations, will not be required. With more efficient preliminary training, development of petty officers competent to assist in the work, and the elimination of drills given better on shore, there ought to be time in fighting ships to complete the training of gun-captains and gun-pointers.

While the individual training of gun-captains and gun-pointers is the all important work, the necessary drills and instruction should not be overlooked. Under supervision that will prevent injury of material, guns' crews should acquire by progressive instruction such practicable knowledge of the care and manipulation of guns and mounts as may be of possible use in time of battle. Restricting to a large gunner's gang the entire care of the battery, aside from polishing bright work, may keep the battery in fine condition, but it is at the expense of the general

efficiency of the crew. Before using any part of the ordnance outfit men should know how to handle it properly.

Instruction in ordnance should be limited to what is essential for the intelligent care and handling of guns and ammunition; as far as practicable, it should be given in connection with gunnery exercises so that it may be both practical and progressive. Its character for the different ratings should depend upon their duties at general quarters, but there is much instruction of a general character that should be given to all enlisted men. A little time each week properly employed is all that is needed for this.

All gunnery drills should assimilate battle conditions. To neglect filling the division tub or issuing tourniquets at general quarters seems a trifling matter, but when needed in actual service the tub may be found to be leaky and sufficient tourniquets lacking. Short, spirited drills have an excellent effect upon a ship's company, but in working for a record care should be taken that efficiency may not be sacrificed to celerity.

Infantry and Artillery.

Infantry and artillery drills have no place in a ship's routine. Equipping and forming companies and battalion, and the manual of arms may be done on board ship, but as a rule this part of the training should be done on shore. The necessary attention to these drills should be given during the early training, and at such times as ships may be ordered to ports offering the required facilities—at least once a year. When this occurs a plan of progressive drills should be laid out for the time available so as to give officers an opportunity to prepare their respective commands for the general drills before battalion and brigade evolutions are attempted. Naval battalions landed to protect life and property require able squad leaders, and during the preliminary exercises much attention should be given to the practical training of petty officers for this duty.

Ship's battalions should be organized for actual service with an efficient nucleus of the crew remaining on board to perform any duty that may be necessary. For parades such changes in the regular organization could be made as may seem desirable.

In receiving ships and at shore stations infantry and artillery drills can be used to great advantage in breaking in recruits,

preventing slouchy condition of men awaiting transfer, and in exercising petty officers in their duties as squad leaders.

SIGNALS.

Next to well trained gun crews the fighting efficiency of the enlisted force demands a well trained staff of quartermasters and signalmen. The formation of a regular signal corps at present does not seem either necessary or expedient, but the selection and training of men of good character and superior intelligence for this branch of the seaman class demands especial attention on account of the large number of torpedo boats and other small craft which require quartermasters, qualified for responsible duties, to assist the small number of officers assigned to these vessels.

Quartermasters not only should know all about signaling, and the practical use of the helm, log, lead, and compass, but they should be trained seamen and have a general knowledge of man-of-war life. To get men with the desired qualifications they should be selected from the *petty officers* of the seaman class who have received only general training up to the time of selection. This duty is not popular with the men at present on account of the arduous work; and in order that the pay may correspond to the duties performed, all quartermasters standing watch should be petty officers first class. Quartermasters should be assigned to the gun divisions that they may assist in the instruction of the lower ratings in signals, and receive such individual training as they may need.

Signalmen should be selected from the ratings below coxswain; that there may be a sufficient number of properly qualified men to choose from, $2.00 per month additional compensation should be allowed every man of the seaman class who qualifies and continues proficient in signaling, as shown by such quarterly examination as may be prescribed. Yeomen stationed on deck at general quarters should be required to qualify in signals on account of the possible assistance they might give the signal staff in battle.

Complete signal outfits should be supplied with special view of their being utilized in instruction. Manuals should be prepared containing in condensed form such part of the introduction to the general signal book not confidential, and such other

special information as quartermasters and signalmen should know. At training stations and in receiving ships every facility should be afforded men of the seaman class under instruction or awaiting transfer to improve their knowledge of signals, especially after the adoption of wireless telegraphy.

SEAMANSHIP.

The art of seamanship cannot be reduced to rules, but the acquirement of a practical knowledge of the essential parts should be systematic, as now there is neither the long apprentice-ship nor enforced opportunities of the old navy in which to gain it, and the handy resourceful seaman must be trained up in other ways.

In addition to such sail and spar training as may be considered advisable, the course in seamanship should insure a thorough, *practical* knowledge of the following: helm; log; lead; compass; nautical terms commonly used; names and chief characteristics of all kinds of vessels and boats; names of parts of ship and ship fittings; knots, hitches, bends, seizings, and splices of practical use in modern ships; kinds and special uses of different kinds of rope and small stuff; blocks and purchases in common use, with the advantage or power gained from each; palm and needle; kinds of canvas and the proper care of it; boat equipments and fittings; pulling a good oar; steering a boat by compass and by range; care and handling of boats under oars and sail under all conditions; boat salutes; lowering life-boats and use of life-buoys; rules of the road with special reference to boats; running lights; fog signals; buoys; lighthouses; tides and currents; and ground tackle. In view of the relative value of the strictly military training which fighting efficiency demands, and the brief average length of service of men in the seaman class—less than four years—it is not expedient to attempt to crowd in anything more.

The number of officers who consider experience in masted ships an essential part of the training of a modern man-of-war's man is rapidly decreasing, the most decided change of opinion being among those who have served very recently in cruising training ships. But among the adherents to sail and spar training for recruits there are a number of progressive officers, whose standing in the service is such that their views should be con-

sidered. While there is such a division of opinion it may not be a wise move to do away with sails completely in the preliminary training. But the limitations of this part of the training must be recognized; there is neither the time nor incentive for turning out the efficient sailing ship crews of a few years ago when seamanship was the major part of a man-of-war's man's education.

The greater part of the efficiency of sailing ships for training seamen is in a great measure due to the necessity of a well drilled, well disciplined crew to meet emergencies in which the safety of the ship may be involved. Self-preservation and self-interest act as stimuli towards gaining the efficiency that will insure security. As soon as some equally advantageous incentive can be found for drills in mastless ships, then in a great measure the necessity for sails and spars for training will have ceased. With war impending there would be no difficulty in finding it, but in peace time there seems but one solution of the matter—arouse enthusiasm by competition, with liberal reward and recognition for those who excel.

The training in masted ships having for its chief object the development of physique and the formation of character, the drills and exercises in these vessels should be exclusively of such nature as to get the best results from activity aloft. Gymnastics and sword exercises are not needed, artillery is out of place for lack of room to drill properly, and infantry must be limited to the manual for the same reason; great gun target practice cannot be held in accordance with the regulations and seldom to advantage. So it would seem expedient to reduce the time spent in this class of ships to three months, devoting the entire time to seamanship, with an occasional infantry drill to brace up the recruits, and sub-caliber target practice with small rapid-fire guns carried for this purpose. Restrict the course in sail and spar training to what can be thoroughly mastered in the limited time allowed, and progress slowly so that every drill and exercise may be carried on with the dash and snap that is the primary cause of having them, working always quickly and quietly to the boatswain's pipe.

The character of the instruction in seamanship and the amount of time to be devoted to it during the preliminary training have already been stated. In the general service it should be con-

tinued until each man in the seaman class becomes proficient in the essentials named. Every opportunity should be given the men to gain practical experience, the details for seaman duties such as helmsmen and leadsmen being frequently changed. More important than all else is that the regulation providing boat drill for *all* enlisted men should be carried out. Boats should be exercised under adverse circumstances so that the men may learn from experience what to do in emergencies and what chances to take. At present the greater part of the training of boats' crews is either under the direction of inexperienced coxswains, or it takes the form of fleet drill during which the attention of officers is for the most part taken up in reading signals.

English.

In respect to facilities afforded ambitious enlisted men to make up for lack of early education our service is far behind other naval powers. A false impression exists, even among some naval officers, as to the character and extent of the instruction in the elementary English studies that the apprentice training system provides. During the few months that recruits are at training stations little progress can be made towards providing a common school education unless the facilities are much improved and a considerable portion of the time is devoted to that exclusively. The provision for the instruction of the illiterate on board ships is too general to be effective. Fortunately few who cannot read and write are to be found among the crews, but there should be none.

The lack of a good course in the elementary English studies seems sufficient reason for raising the age limit of recruits to 16 and for making the educational qualifications for enlistment higher. Even then the service should afford facilities for self-improvement in this respect. School books should be supplied to crews' libraries and made available during recreation hours, and provision should be made for giving such assistance to those needing or wishing it as the good of the service dictates; compulsory attendance at instruction of this kind is of doubtful value. In some foreign services a school master is still employed for this duty on board ship.

At opportune times, such as long winter evenings, a course

of simple lectures should be given, and illustrated by stereopticon views when practicable, that the enlisted men may know something of the history of our country, especially the history of our navy, get an insight into the character of our government, its advantages and our individual responsibilities, and other matters of a similar nature. This would not only afford amusement but also inspire respect for our institutions, pride in our resources, love for the flag, and loyalty to the service. Its influence upon seamen of foreign birth would be most beneficial.

First Aid and Hygiene.

That a thorough practical knowledge of the use of the various articles supplied for first aid to wounded, and that the health of the crew may be safeguarded as much as possible, there should be systematic instruction carried out under the supervision of medical officers. One who has been most successful in this work suggests the following course, which for convenience is divided into six lectures, each requiring a period of three-quarters of an hour, including the time for necessary practical work:

Lecture 1. General circulation of blood. Causes and kinds of hemorrhage and means for control. Description and practical application of tourniquets.

Lecture 2. Description of first aid package, with practical applications of all its parts, and ordinary bandages; also triangular and roller bandages.

Lecture 3. Methods of transporting wounded men on board ship and on shore. Practical application of emergency splints and dressings, and other first aids to injured and wounded.

Lecture 4. Rescuing and resuscitation of drowning, and revival of persons unconscious from various causes. Description and use of contents of medical boat boxes.

Lecture 5. General ship and camp hygiene. Bearing of drills and exercises upon health and physical development.

Lecture 6. Effects of alcohol and other narcotics. Personal sanitation and general hygiene of clothing and foods, with special reference to care of men while on liberty.

That benefit would be derived from including such a course in the yearly work cannot be doubted; generally the instruction could be given during bad weather or when other circumstances interfere with routine drills.

Miscellaneous Instruction.

There is a great mass of general information, which does not belong to any particular branch of training, but on account of its important bearing upon results obtained, should be imparted to all enlisted men during the early part of their career. In this may be included explanation of watch, quarter, and station bills, and the system of alarms and bugle calls; suggestions as to care and cleanliness of clothing and person; instruction in plain sewing; swimming; keeping personal pay accounts to impress value of money and cost of clothing upon recruits; explanation of rank and ratings of all officers and petty officers and insignias of rank, conduct towards officers, and relations existing between officers and men; the traditions and unwritten laws of the navy as well as the Articles for the Government of the Navy that have a particular bearing upon the conduct of the enlisted personnel; the desirable qualities of a good man-of-war's-man; deportment on shore, at home and abroad; conduct in case of brawls; the proper way to get redress for wrongs; information concerning ports to be visited, in this connection charts and maps in glazed bulletin boards for use of crew are much appreciated.

The ten minutes allowed for oral instruction at evening quarters is suggested as the best time for the greater part of such instruction.

In the course of the day's work steps should be taken towards systematic development of mechanical ability, and every man in the deck force should be taught how to handle such tools and mechanical devices in common use about the decks.

Supervision and Inspections.

Proper spirit may be infused into the system by careful supervision and thorough inspections of every stage of the training. It should be foremost in thoughts of everyone from the members of the General Board down to the divisional officer. The importance of the work should be emphasized by the personal interest in it shown by commanders of squadrons. The same applies to captains and executive officers whose presence at drills and exercises inspires both officers and men to strive harder to excel. That the training may have the benefit of the general attention of these officers they should be relieved of some

of the routine work of lesser importance which requires so much of their attention at present, everything else should be made subordinate to efficient training.

In the larger ships the demands made upon the executive officer at present leaves him little time to devote to the supervision of drills, the most important duty of all. Some of the work required of him should be distributed among his juniors, or following the custom in most foreign services, an additional officer should be assigned to each vessel to relieve him of some of his present duties, so that he may have ample time to keep himself well informed of the state of efficiency of every unit of the fighting force of the ship.

The better development of the petty officer will relieve divisional officers of many minor duties which will make it possible to give the general work of divisions far better supervision.

At all inspections the attention given to various details should be according to their relative importance. The progress in training should be carefully inquired into, and opinions as to the efficiency of the system and the changes in it that are considered desirable should be ascertained. The state of health, contentment of the crew, and privileges granted should be looked into with the same care as the state of cleanliness of the ship. In case of numerous desertions the probable causes should be investigated in order to eliminate them from the entire service.

Inspections of the present training ships, while following the same general lines as those in the regular service, should be so modified as to suit the type of ship and the nature of the work done. They should be of such character as to bring out the proficiency attained in the detailed instruction as well as at general drills. Inspections with the ship underway are undesirable.

The naval training staff should make frequent inspections not only to note and report upon state of efficiency reached, but also to obtain a clear understanding of the practical working of the system, and by keeping in close touch with every branch of the training, learn in what respects the system may be improved, especially as regards assistance given by the department.

Excellence shown by individuals or by ships should be made a matter of record and the results of inspections should be

published for the information of the service, especially in all cases of exceptional efficiency. Include in these reports the divisions, gun crews, and boats that excel with the names of the officers and petty officers in charge. By thus indicating the importance of efficient training, self interest and a spirit of rivalry will put the life into the work that is much needed at present.

Examinations.

The quarterly examinations, provided for by the Navy Regulations, should be more carefully conducted. While extremely tedious in the case of large divisions these examinations keep divisional officers in touch with their men and give them an insight into their character and intelligence that is not always gained in the daily work. They will also demonstrate the efficiency of petty officers as instructors and show adherence to the system.

These examinations should be of such a character as to bring out the practical usefulness of the men; "show what you can do" rather than "tell what you know." By demonstrating, without fail, any individual improvement, they can be made a powerful stimulus for self advancement.

Records.

While deprecating the vast amount of clerical work involved in the administration of naval affairs, a correct record of all work done and individual progress made is regarded as essential to systematic training. In this respect give the enlisted personnel the same treatment as material; require a uniformly kept record of every stage of development. The enlistment record in its present form does not fulfill such requirement. It is suggested that a more compact form be used, the entries under professional qualifications showing the exact character of all training received and proficiency attained at each stage. This could be done by following the same method in all branches recently adopted for gunnery; but, in addition to the letter denoting stage passed through, use a mark on a scale of 5 to show merit of work done; thus A 4 under seamanship would indicate "very good" work in the first stage of seamanship instruction. When there has been nothing in the nature of systematic training in a branch during the period for which entry is made in the enlistment

record the fact should be indicated by an adopted symbol. Such a record will clearly show a summary of training received and fitness for special branches, also what instruction each man should receive to bring him up to the proper standard for his rating.

The entries on the enlistment record should be made up from a "progress book," kept by the divisional officers who have supervision of the work and are responsible for individual progress made. In this book should be entered the result of examinations in each branch of every enlisted man at the time of assignment to the division; a summary of all training received and progress made in each branch; results of quarterly examinations; scores at all target practice, with such marks as may be useful to indicate exceptional qualities, good or otherwise.

Monthly reports should be required showing the average number of hours systematic training of all the enlisted men in each ship in commission; the division of this time among the various branches; the number of enlisted men excused from such training, and such pertinent remarks as may be of use to those in general charge of the training to improve the system. Prescribed blank forms for these reports should be supplied, also suitably ruled progress books, that the time required for keeping the record of training may be reduced to a minimum; and where-ever practicable reports should take the form of memoranda.

A scale of punishments for minor offenses should be adopted that the enlistment record may be a surer indication of general conduct. To this end it would also seem desirable to have the marks in conduct depend partially upon other sources of information than the regular report book.

Self-interest will tend to stimulate men to better work, when a well kept record assures recognition of individual improvement and advancement according to merit, preventing worthy men being overlooked while the undeserving are advanced. Pride in professional qualifications should be awakened by posting marks quarterly and at such other times as they may be of interest to the enlisted men.

QUALIFICATIONS.

Whether a general system of training meets with favor or not, the good of the service demands the immediate adoption

of standard qualifications for each rating. The necessity for this step and the benefits to be derived are too evident to require further comment. The qualifications as to citizenship, age, physique and professional ability in each branch should be stated clearly and fully for each rating. The character of the examination given preliminary to advancement in rating should be outlined, and the officers to constitute the board of examiners should be named. The hand-books issued to the men to assist them in self-advancement should give the requirements of each rating in detail. The standards should be maintained as high as practicable; at such times as the available trained force permits, the least desirable should be weeded out, thus raising the standard of the whole. There should be special instruction for the dull and backward, and petty officers who fail to continue efficient should be disrated. To expedite the removal of petty officers lacking the qualifications of their respective ratings, the officers of the examining board for that rating should investigate and submit a report to the senior officer present, whose action in the matter should be final.

The qualifications for admission to the special courses of training should be carefully considered. It would seem that the special advantages gained by taking such course could be made an incentive to good work if properly held out to recruits, and the selection of the men to take these courses be limited to those who had qualified as seamen, shown special fitness for the course, and had been under training for at least two years. Physical qualifications should also be duly considered.

Except in an emergency transfers should not be made from one step in the training to the next higher until men show themselves to be qualified. This is especially the case in the preliminary training where the recruit is so carefully shown the first essential principles of ship life, and failure to learn them then—the proper time—proves a stumbling block during his whole career.

Advancement in Rating.

The selection of the best fitted men for higher training and the employment of petty officers to make best use of their ability are of so great importance that advancement in rating should be strictly according to merit as shown by individual

records in sea-going ships. The general service is the practical test of qualifications, both as to character and ability.

With the qualifications for each rating clearly defined, it would seem desirable to give commanding officers more latitude in issuing acting appointments to petty officers. The present system ensures uniformity, but the delay in securing the Department's action in cases of enlisted men tends to have a disorganizing effect.

Strict compliance with the regulations may be ensured by having all advancements reviewed by the Department.

The movement to keep men in one ship as long as possible makes it practicable to fill such vacancies as may occur in the lower ratings by the advancement of men already on board. Placing ships in commission will be so frequent that all continuous service men will be needed for them, and the transfer of such men to ships already in commission will be infrequent. Advancement according to merit ought to be an incentive for good work in every ship.

The regulations provide for advancement in rating of apprentices at the end of specified times. The qualifications required for advancement should correspond to the time limit, and provision should be made for the discharge of those failing to qualify upon second trial. Similar provision should be made for the advancement of landsmen for training, and in other ways equalize the advantages for all recruits.

Discharges and Weeding Out.

The whole enlisted force should be so much in excess of the number required to man ships in commission as to give a good working margin for properly disciplining the unruly and getting rid of the worthless. At shore stations undesirables should be most carefully weeded out, and recruits that show indications of being vicious characters should not be included in drafts for transfer but be held back for further observation. Recognized bad characters should not be tolerated in the service, especially in training ships where their evil influence is far-reaching; their immediate discharge should be made possible by giving the senior officers present authority to order it, especially if it be by sentence of summary court-martial or recommended by a board of officers after investigation. The practice of giving men

another chance after flagrant violation of the regulations is of doubtful advantage. Many good men leave the service rather than continue with such undesirable associates.

At such times as the recruiting and early training furnishes all the men required for general service there should be systematic weeding out of the least desirable men, thus raising the general tone of the whole enlisted personnel. The privilege of purchasing discharge might also be restored with advantage; the retention in the service of the discontented is of the nature of compulsory service, which may insure numbers but not necessarily efficiency. A considerable number of these men going out in civil life after a period of training will constitute a valuable reserve that may prove most useful in time of war. In this connection Mahan says: "Is it nothing in an age when authority is weakening and restraints are loosening that the youth of a nation passes through a school in which order, obedience, and reverence are learned; where the body is systematically developed, where ideals of self-surrender, of courage, of manhood, are inculcated, necessarily, because fundamental conditions of military success?"

Pay, Inducements and Rewards.

As a result of numerous inquiries among men of various ratings it is learned that the present pay is generally regarded as satisfactory. But the recognition which performance of duty receives is a matter of pride, and the money value placed upon the services rendered is taken as an indication of the relative worth of the different ratings in a ship's complement; by such a comparison the chief petty officers of the seaman class do not get what their responsible duties entitle them to, and their pay should be increased accordingly.

Short service is one of the chief obstacles to efficient training. Among other inducements to obtain greater average length of service necessary for the development of efficient men-of-warsmen additional pay in case of re-enlistment should be considerably increased. The value of trained seamen justifies such action, and money spent in retaining men will be saved many times in expense of recruiting and training.

Extra compensation for special acquirements is a great incentive to earnest application, and is justified by the greater general

usefulness of the men who qualify in the special branches. Such additional pay should continue as long as quarterly examinations show that the qualifications are maintained or until advancement to a rating which requires such qualifications.

But good pay is not enough. The principal reason given for desertion or failure to re-enlist is the lack of uniformity with regard to comforts, privileges, punishments, and the uncertainties of the enjoyments of the life generally. It is by attention to them rather than to increased pay that long service must be secured. To recruit and retain the desirable class of men, the navy must compete with civil life and offer a respectable and inviting career. It is evident that the rewards now bestowed for long faithful service are not having the desired effect in increasing the number of continuous service men, and other inducements must be offered. Advantage should be taken of the national desire for change of scene, and during cruises men should be given an opportunity to cultivate a desire for sight-seeing and travel that will have some influence in keeping them in the service.

There are many positions of trust and benefit in navy yards, and in the civil departments, especially the Light House Service, for which men-of-wars-men are specially fitted. If in filling such places preference were given to retired seamen with good records, a premium would be placed upon honorable service, the country would continue to gain benefit from men trained at considerable expense, and in event of war these men would be in a position to render valuable assistance to the fleet.

More good men would continue in the service if they felt sure that their best efforts would be duly rewarded. Much harm has been done by offering inducements that could not be fulfilled at all, or only with injury to the service; their enforced discontinuance can only be regarded as a breach of faith, amends for which are made with difficulty. While holding out the possibility of rapid rise to appointment as warrant officer, with the attendant advantages, it should be clearly pointed out that the great majority must be satisfied to remain in the enlisted force, the principal object of the training being to furnish efficient petty officers and men contented to wear a blue shirt.

Self-interest is the determining factor where time and labor are involved, and rewards as well as punishments should be used

in maintaining discipline and stimulating ambition to be foremost in all duty. Well-doing has been regarded as the normal state of affairs, and excellence has not received deserved recognition. While trying to avoid inciting envy, there should be a marked difference in the general treatment of men who excel and the ones who are indifferent. Not only for gunnery but in every branch of the training there should be prizes for those who rank first according to a carefully kept record. More rewards are needed similar to the Bailey medal given annually to the most proficient apprentice. In addition to pecuniary rewards, special privileges might be accorded to encourage individual efforts. It has been suggested that proper recognition of general excellence in gunnery would be shown by giving the crew of the ship the right of the line at brigade reviews and formations, and giving the best division of each vessel a similar position in the ship's battalion.

Discipline.

A military writer has defined discipline as that quality which makes obedience second nature, and causes man to accept without question the powers and limitations of his rank. The usual evidences of discipline are military etiquette and ceremonious marks of deference to military superiors; the best evidences being endurance of necessary hardships without grumbling, and willing, energetic, and intelligent performance of duty.

Americans are not naturally susceptible to a high state of discipline, but when it came to active service during the Spanish War the "best evidences" were apparent everywhere, and the general state of discipline was most excellent. There is unbounded faith in the men responding quickly in an emergency, but there can be but little pride in the outward evidences of the state of discipline, by which civilians and foreign naval officers gauge the efficiency of the navy almost entirely. The lack of deference shown officers by enlisted men is the natural outcome of existing conditions; it is due to their close touch day after day, frequently under circumstances where the required dignity and reserve are out of place. At present officers are forced to give too much of their time to trifling matters, doing too much petty officer's duty, sometimes badly, to retain that high regard of the men essential to a fine state of discipline. While deplor-

ing this lack of deference to rank, there is a tendency to shirk personal responsibility for its improvement. The task demands united action, and individually " we ought not to begrudge those daily sacrifices and minor offices, which, distasteful as they may be, are the *sina qua non* of true discipline and efficient organization." *

In considering the improvement of the state of discipline there should be a frank recognition of the faults and weaknesses of the men as well as their possibilities. One of the chief causes of discontent is the lack of uniformity in enforcing discipline; certain kinds of misconduct being tolerated in some ships while severely punished in others. Uniform and explicit regulations should be laid down to govern the internal discipline of ships. These should be presented in such form as to prevent any chance of misunderstanding, as many infractions are due to inexplicit orders.

With the constantly increasing enlisted force and changing conditions, the present means for enforcing discipline are not effective. A general revision of the laws relating to the administration of justice in the navy has been urged repeatedly. It has been proposed that a new code of laws be prepared for submission to Congress, with a view to the simplification and proper classification of offenses, providing unvarying punishments for each infraction of the regulations and additional penalties for repetition of an offense. In making such a revision, summary punishment for the more serious offenses should be insured by less cumbersome rules for summary courts-martial, or by extending the authority of commanding officers. The latter would be the most expedient as the reduced number of officers in the smaller vessels makes trial by courts-martial difficult. Divisional officers, too, should be given the same authority to enforce discipline in their own divisions as obtains for officers commanding companies in the Army and Marine Corps.

The ineffectiveness of some of the present forms of punishments leads to consideration of changes that will prevent frequent repetitions of the same offense. Withholding pay being generally non-effective as a punishment on account of the facil-

* Captain C. F. Goodrich, U. S. N., in " Esprit de Corps."

ities for leaving allotments, and the deprivation of liberty on shore being a doubtful expedient, it is suggested that there be but two conduct classes—one deserving every consideration in the way of privileges, and the other being accorded none; but every restriction should be removed when a second-class man is restored again to the first class. The substitution of fines for the more common forms of punishment on board ship is said to have given good results in the British navy. Brief terms of confinement are not generally regarded by men as much of a hardship, and except for offenses of a vicious character the disadvantage of losing the services of men during long terms is so great that an effective substitute is desirable. But when it is resorted to, loss of pay for the term of confinement should follow to make the punishment more keenly felt.

While it is not policy to notice every little infraction of regulations, serious offenses should be severely punished, and in the case of deserters every means should be used to detect and bring them to trial. Such measures will insure proper respect for discipline and authority.

CONTENTMENT.

Contentment depends on the physical comforts—messing arrangements, privileges, and punishments—more than on the amount of work and pay. In this connection it is interesting to read from the memoirs of the great naval commander who contributed so much to Nelson's victory at Trafalgar. "Lord Collingwood carried his system of arrangement and care to such a degree of perfection, that perhaps no society in the world, of equal extent, was so healthy as the crew of his flagship. She had usually eight hundred men; was, on one occasion, more than a year and a half without going into port, and during the whole of that time never had more than six, and generally only four on her sick list. This result was occasioned by his attention to dryness (for he rarely permitted washing between decks), to the frequent ventilation of the hammocks and clothes, to the creating of as much circulation of air below as possible, to the diet and amusement of the men, but above all, by the contented spirits of the sailors who loved their commander as their protector and friend, well assured that at his

hands they would ever receive justice and kindness, and that of their own comforts he was more jealous than of his own."

Life in the navy must be made as comfortable and respectable as possible. There must be material attractions, manifest from the outset, during the early training as well as in the fighting ship. The causes for the general contentment in the so-called happy ships should be investigated with a view of bringing about a similar state throughout the service. To prevent frequent misinterpretations of orders and wishes implied, detailed instructions should be issued clearly setting forth the policy of the Department with regard to comforts and privileges.

The physical comforts of the crew should not be sacrificed needlessly as an economical or disciplinary measure; they should be duly considered in designing ships, the general surroundings of which should be conducive to contentment. On the upper decks and between decks there should be sufficient light at all times for the crew to carry on work or amusements without difficulty; this is also in the interest of cleanliness and discipline. The facilities for bathing, and scrubbing and drying clothes should be improved still further. Give each man on board ship a bucket for his personal use and a regular place to stow it; these could be made out of galvanized iron, fitted to stow inside one another and take up less room and be cleaner than wooden buckets in present use. A small electric centrifugal dryer and a drying room seem a much needed addition to all ships and stations. The distilling apparatus on board ship should be sufficiently large to supply without difficulty the required amount of fresh water for ship's use; one of the chief sources of discontent among enlisted men is the cutting off the usual allowance of wash water, and also having to drink warm water, as is now frequently necessary.

Sufficient space should be regularly allotted to every man for the proper stowage of such parts of the outfit that he is required to have which cannot be kept in his bag or ditty box. It is in the interest of the health, comfort, and discipline of the crew that rain clothes and rubber boots should be kept ready for use; separate compartments in specially constructed lockers on deck should be assigned each man for this purpose. The way in which these articles are generally stowed at present results in delay in breaking them out, and frequently in their loss. In

training ships such rain clothes lockers are an absolute necessity. The messing arrangements have been a source of much discontent and the general mess has been most unpopular with the men, who regarded the management of their own messes as a vested right. But the gratifying results of the recently adopted commissary system in some ships show that where it has not proved satisfactory the fault is not in the system but in the inefficient manner in which it is operated.

It is not enough that seamen should be well paid and well fed; they must be given opportunities to enjoy their earnings. Shore leave should be granted under favorable conditions; in case the duty of ships is such as to necessarily restrict the usual privileges and comforts of the enlisted men, when practicable, they should be ordered to some port offering proper facilities for giving liberty. This, as well as deserving leave for deserving men during the holidays at the end of a cruise, or while a ship is undergoing repairs that interferes with routine work will be duly appreciated, and the results of training will be better on account of the general contentment that follows. Some years ago during the winter evolutions on the Southern drill ground, the North Atlantic squadron made several trips to New York for the special purpose of giving liberty; and at the close of the manœuvres last summer, the torpedo flotilla, on its way from the New England coast to Norfolk, stopped at New York for the same purpose. The increased pride which the men felt in receiving such consideration counted far more than any increase of pay.

A majority of recruits enter the service from a desire to see something of the world; in fact, it is one of the chief inducements offered. Sight-seeing should be regarded as an essential part of the training, and during foreign cruises such privileges should be accorded men as not to dispel entirely their romantic visions of navy life. When opportunities in the way of visiting places of interest make it desirable, day liberty should be granted, giving it for longer periods and less frequently. During the absence of a part of the crew the work and training of the remainder should continue without interruption; there seems no real reason for the disorganizing effects that frequently result from giving liberty. Men should be encouraged to sleep on board, and to facilitate their return to the ship night boats should be run as late as practicable.

Every indulgence consistent with efficient training should be granted to deserving men, there being a wide mark of distinction in the treatment of such men and the troublesome members of the crew. With a view to alleviating hardships the men should be studied individually and collectively, as different types of men require different treatment. The enlisted men should have impressed upon them their own responsibility and the effect of their conduct on general contentment.

Recreation and Amusements.

Discipline and contentment are not inconsistent. The training should be strict but means of enjoyment provided. Every practicable sort of amusement should be introduced in the service to make men contented and fond of their ships. Not only the scope and character of the drills should be outlined but also the hours for recreation and the times for giving liberty, that there may be general uniformity in this respect, too. The music furnished by bands allowed flagships and the larger training ships do much good. The formation of volunteer bands and orchestras in the others should be aided; and boxing, wrestling, minstrel shows, and other entertainments for the crew should be systematically encouraged.

Attempt should be made to direct the general trend of the thoughts of the men during leisure hours. The way the mind is occupied during this considerable part of each day will have a marked effect upon general efficiency; and healthful sports, amusements, and reading matter should be provided to insure that buoyancy and cheerfulness so essential to contentment. The excellent library now furnished ships for use of crew should be enlarged so as to include such elementary school books, professional books, and drill manuals as may be of use to petty officers and drill masters, and to ambitious men working for self-advancement. Popular naval histories and works of fiction similar in character to "A Man Without a Country" should be added. Subscriptions to a number of the leading newspapers and magazines for the use of the crew will afford benefits that will justify the time and attention that such arrangements will necessitate. The care of both library and newspapers should be placed in charge of the chaplain or a responsible petty officer, and the rules governing the issue of books should be such as to

make them available daily; suggestions to promote circulation of books and increase the general use of the library should be encouraged.

The educational value of play should be made use of in the general development. The ceaseless activity of the younger recruits should be directed and utilized in sports that will not only tend to build up the body physically but give that mental stimulus that develops quick perception, rapid judgment, and prompt decision. Mere physical exercises afford little enjoyment; there must be some cause for enthusiasm that will bring out vitality, spontaneity, and zest; develop will power and an instinctive condemnation of what is unfair. When the Duke of Wellington, late in life, sat watching a game of football among the students of Eton College, he said, "There's where the battle of Waterloo was won." *

While such attention to details may have the appearance of coddling, with the proper spirit infused into daily drills and exercises, granting such indulgences ought not to make the men less ready to endure hardship or face danger when necessary, and the contented letter to people at home will be a most effective means of acquiring recruits.

Systematic Training of Men Not in Seaman Class.

The difficulty experienced in recruiting a sufficient number of well qualified artificers, mechanics, yeomen, and cooks shows that provision must be made for giving all enlisted men a course of systematic training in their respective branches of the same general character as that which has been outlined with special reference to the seamen class. At receiving stations there should be preliminary courses of training that will prepare recruits to go aboard ship and undertake their duties at once.

The hospital corps is in a most satisfactory condition as a result of progressive training since its organization a few years ago. The schools recently established for yeomen, electricians, and cooks are also doing good work, though badly handicapped by lack of officers to give them proper attention. The training of coal passers in torpedo boats in reserve has met

* Dr. John E. Bradley in "Review of Reviews."

with success. But all of this training should be put on a firmer basis, with a well defined policy, and under the general direction of the office for naval training to insure proper co-operation and co-ordination of all branches of the work. The facilities at navy yards should be used to assist in developing proper engine-room and fire-room forces, and apprentice ships established to provide skilled artificers and mechanics for fighting ships. Transfers from the seaman class to the fire-room or messmen class after a considerable period of training are made at a distinct loss in time and expense. It is suggested that in receiving ships and barracks a sufficient number of ship's cooks fourth class be kept under instruction to supply the general service. This measure will have the double advantage of recruits getting valuable practice under experienced cooks, and performing work that must otherwise be done by men in seaman class at a loss of time for their special training. At present messmen reduce considerably the average fighting efficiency of the enlisted force on board ship, and a supply of good mess attendants is becoming a matter of importance. There ought not to be a large foreign element on our ships for any purpose, and means of getting a desirable class of Americans for this duty should be considered.

The proper sphere of work of the naval militia should also be decided upon, and the necessary course of training laid out.

SUMMARY.

The following are the leading measures advocated in the preceding discussion:

1. Adoption of a general system of naval training.
2. A staff for the general direction and supervision of the training of the enlisted force.
3. A progressive course of training from landsman to chief petty officer.
4. One year's preliminary training for recruits of seaman class.
5. Sailing brigs and gunnery vessels attached to shore stations.
6. Transfer from training stations direct to general service.
7. All advanced training, except for seaman gunners, to be in regular service.
8. Standard qualifications for each rating.

9. Well kept records of training, and advancement according to merit.

10. Closer supervision and more thorough inspections.

11. Thorough weeding out of undesirable characters.

12. Readjustment of pay for certain ratings.

13. Offering additional inducements and rewards for long service.

14. More attention to physical comforts and general contentment.

15. Better development of petty officers.

16. New code of laws for administering justice in the navy.

17. Systematic training in their respective branches for all enlisted men.

18. Uniformity in all matters of organization, internal regulations, general alarms, privileges and punishments.

Advantages.

By adopting such measures, expediency gives way to a well planned system of progressive training; with thoroughness insured by proper supervision; the scope increased by better distribution; co-operation in all its branches carried on at no greater expense; requiring much smaller force for training; warrant officers and chief petty officers relieving divisional officers of many of the details; a guide for varying conditions, and of great assistance in laying out the day's work. Standard routines, courses of instruction, scales of punishments and internal regulations will deprive ships of much of their distinctive character, and it may detract from the efficiency of some, but in a greater number of cases it will root out an individuality that is injurious, and make it practicable for officers and petty officers to take up the work at any stage with facility. In case the length of time of preliminary training be considerably reduced, such a system will be needed all the more to insure uniformity of the early training in a large number of ships in the regular service.

It will take some years to thoroughly develop such a system, but its advantages will become evident as soon as petty officers begin to take their proper positions in a ship's company.

Defects of the System.

Some of the defects that will be ascribed to such a system are that it is not practical, is too elaborate, destroys individuality, and introduces additional clerical work. But the constantly growing service demands some well defined policy in training and a poor system is better than none at all. If the one adopted does not always prove practical then regard it as the ideal. Attention to details is necessary to obtain uniformity. No better example of the advantage of such attention can be desired than the target firing of Lieutenant Poyer's turret in the Kearsarge. A broad and comprehensive system is required to develop the resourceful seaman and provide material for warrant officers. With a progressive instruction, well distributed, men should not grow stale from over-training, or become mere machines. A rigid system tends to destroy individuality in ships. But, Mahan says that the "whole of military action is contained in the word unity," and to secure the implied unity of action in battle there must be uniformity in previous training.

There are some that will condemn any system that involves additional clerical work. But consider the time spent on indicator cards. Are not the personal elements in ships of equal importance to the cylinders; and should their work be less carefully watched and studied with a view of making such adjustments (in the system) as to secure the greatest efficiency? There is no desire to devote less attention to material, but to give the same amount to personnel.

This question of training has too far-reaching effects to be viewed narrowly—limited to one's own personal experience—the opinions of others should be carefully considered. The system should be prepared under the direction of the General Board, or submitted for approval, and the measures adopted should be ones insuring the highest state of fighting efficiency of the whole naval force. Any plan that receives such approval should be given that hearty co-operation and assistance so essential to its successful operation. Personal prejudice to existing measures has sometimes permitted obstructions to be placed in the way of the work of training, trusting that failure would lead to a change of policy. Individual wishes should take the form of suggestions for official action, and the pointing out of defects

should be encouraged. Proper co-operation will insure the elimination of evident faults wherever they exist.

Conclusion.

The writer is aware of the incompleteness and possible inconsistencies of the arguments advanced and that the measures advocated will be regarded as a training ship solution of the problem. But it is hoped that the suggestions in this essay may lead to the immediate adoption of a general system of naval training which will improve the present unsatisfactory condition of the enlisted personnel, and will ensure that preparedness of the navy which is the safest means of maintaining peace with honor.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION.

OUR TORPEDO-BOAT FLOTILLA.

THE TRAINING NEEDED TO INSURE ITS EFFICIENCY.

MOTTO: *We question the utility of torpedo-boats because we don't know how to utilize them.*—W. W. KIMBALL.

By LIEUTENANT EDWARD L. BEACH, U. S. Navy.

By Navy Department General Order No. 49, of June 8, 1901, it is ordered that a torpedo-boat destroyer shall be commanded by a lieutenant, and that a torpedo-boat shall be commanded by a lieutenant, a lieutenant junior grade, or by an ensign. The Navy Regulations do not require that the officers ordered to torpedo-boat duty shall possess special knowledge, experience or training in such duty, indeed under the conditions that have existed for several years in the naval service such experience or training has been impossible to all but a limited few; it is well known that the need of officers for ships in commission has reduced all assignments to shore duty; one of the results of this has been that but few officers could be spared for torpedo instruction at Newport; another result is that but few of our torpedo-boats have been commissioned, and for much of the time all of them have been hauled out of water and laid up under conditions that caused great deterioration.

The great naval manœuvres of England, France, Russia, and Germany, which yearly hold place for the purpose of facing and solving the problems to be expected in actual warfare, have definitely determined that war squadrons should be, and most probably will be, composed of battleships, cruisers, and torpedo vessels. These countries have supplied themselves with the

number of torpedo-boats demanded by their needs, and much intelligent practice with these weapons is exacted of officers and enlisted men.

From its great coastline and outlying colonies, so much of which is unfortified, and in war time under some circumstances would be inviting to hostile attack, the United States has great need of torpedo-boat defence.

From the fact that the navies of these countries, against whom we are preparing to defend our country in the contingency of war, are equipped with great numbers of torpedo vessels, it must be expected that countries with naval bases near to our coasts and colonies would organize to be employed against us in time of war, squadrons of which torpedo-boats would form a part; we must be prepared for such features of warfare as the employment of these weapons would impose.

As the nation has determined upon a naval policy, it devolves upon naval officers to instruct the law makers of the particular features in technical respects of the best types of weapons, and the best means of using them. It is in this way that the knowledge of naval experts properly influences naval legislation. It is the belief of these experts that, considering the present and not trying to discount the future as to the value of the submarine or other possible weapons, the naval sea strength, that is the battle squadrons of a great power, should, as before stated, be composed of battleships, cruisers, and torpedo-boats.

To develop great efficiency in each class for its duties, and in the officers and men who handle them, the battleships for the first line of battle, the cruisers for scouting and other duties, the torpedo craft, when, under favoring circumstances they can be dispatched against the enemy, is the purpose of the great foreign yearly manœuvres. As used in this paper, the term torpedo-boat is generally applied to either the destroyer or the torpedo-boat proper.

The United States has a glorious naval history, much of which has been of single ship actions; the effect is seen in the efforts made in our service to perfect in fighting ability the units of our squadrons; of recent years the importance of squadron drills has become better recognized with practical results. But in all of our naval policy since 1898 it is apparent that our building programme has been deficient in the construction of torpedo craft, as well as in the proper utilization of those that we already have.

All of our ships of whatever type, when kept continually in commission have within reasonable time attained to the most commendable conditions of efficiency. The ships laid up even in reserve with skeleton crews on board, have invariably deteriorated. The splendid Minneapolis after a short commission was put in reserve in Philadelphia; when called into service during the Spanish war she had deteriorated so badly that her boilers had to be retubed. This lesson is repeated every time a ship is laid up. When the Columbia was commissioned for a receiving ship a board of inquiry was called upon to investigate the causes of her bad condition. The torpedo-boat, which combines great powers of speed with greatest frailty, is the most susceptible of all craft to deterioration; after the Spanish war it was impossible to keep these boats in commission because of the need for all officers and men that could be had, for service in Chinese and Philippine waters; and so all the torpedo-boats were hauled out of water and laid up. The effect of this upon the navy was bad; the boats when again called into service, were unfit for use until extensive repairs had been made. If the torpedo flotilla is to be one of our naval weapons, the very nature of the torpedo-boat, of its powers, of the hazardous duties it is to be employed upon, require, that, to be successfully used, its officers and crew must have much drill at their proper duties. As for most of the time these boats have not been in commission, this necessary training has had but little place in our service.

It is the purpose of this paper to inquire into what is needed, first, to insure that at the required moment the offensive power of the boat may be equal to its designed power; and secondly, to insure that its destructive powers may be intelligently directed.

For the writer's convenience this subject will be discussed under the following headings: (1) The conditions that have controlled our torpedo-boat flotilla. (2) Lessons concerning torpedo craft to be drawn from history and from foreign manœuvres. (3) Foreign systems of torpedo-boat training. (4) The torpedo-boat training needed by our navy.

PART I.

The Conditions that have Controlled our Torpedo-Boat Flotilla.

Since the Spanish war our torpedo-boat flotilla has been largely augmented, and now consists (built and near completion) of twenty-six sea-going torpedo-boats and twenty torpedo-boat destroyers, with a number of smaller boats. The characteristics of these boats, the extremes of speed and destructive powers combined with ever-present vulnerability to overpowering accident from within and without, are well known to all naval officers. But is not this about all that is known of them to most of those officers who never have had experience with these craft ?

One cannot dwell with satisfaction upon what, until recently, has been accomplished by our torpedo-boats in peace time; and in the Spanish war they were never in a single instance put to legitimate torpedo-boat work. The Spanish war proved not their destructiveness nor their war time utility, but demonstrated their inherent weaknesses. During this war the tendency was not to test them but rather to preserve them. This was so because there has not existed in this country, either in its legislators or in its naval officers, a well defined, well agreed upon, torpedo-boat policy, either of building, or of exercise with those already built. Naval experts all agree that the country that places any dependence at all upon torpedo-boats needs many of them. They do not admit that the number at present possessed by the United States nearly equals the number required by considerations of sufficient torpedo-boat defense. Believing as he does that in particular cases the torpedo-boat is invaluable to the national defense, and that for these cases our present torpedo-boat flotilla is not sufficient in numbers for such citable instances, the writer would urge the necessity the navy has of demonstrating its ability to utilize for their designed purpose these destructive engines of modern warfare. Until the navy shows that these weapons may be used against us, and also that in war's contingency we might with advantage use them against an enemy, it is not probable that the national legislators will order any more torpedo-boats to be built. During

the discussion upon the last Naval Appropriation Bill, the need of torpedo-boats was not considered. It is submitted that in case of conflict with any of the great naval powers that have bases near to our coasts or colonies, there will be need on our part of torpedo-boats, and that the country should be educated to this need. If the boats are to be hauled out of water and laid up, the country will not appreciate this need until the war is upon us, nor will the navy be trained to handle these boats efficiently.

The history of the torpedo-boat emphasizes in all cases its extreme vulnerability; the practical study of it by foreign navies has developed much knowledge of when and how and where this weapon should be used, knowledge which but a few of our officers have had an opportunity of acquiring. It is not enough that when on hostile destructive intent the boat should be capable of reproducing her trial trip speed; the knowledge of the proper use of the boat is just as necessary; this requires the practical study of the tactical operations of the boat in section; of what has been accomplished by torpedo-boats in previous wars, and in squadron during the great foreign manœuvres; and in each case the particular tactics employed.

Used with wisdom the torpedo-boat becomes a most powerful weapon; used without practical knowledge of torpedo-boat warfare the torpedo-boats become useless for offence, and a weakness and hindrance to their own flag, as instanced by the Spanish destroyers, Furor, Pluton, and Terror, during the Spanish-American War.

We have had torpedo-boats for ten years, during which time we have battled on the seas with an European power, and yet, during this time, at peace and at war, until most recently our officers have never had opportunity to exercise these boats under simulated war time conditions. Individual instances may be cited where boats that have been kept continually in commission have attained to a high standard of efficiency as regards their handling and their speeds; but with the exception of the section of boats once commanded by Lieutenant-Commander Kimball, and a later section commanded by Lieutenant Chandler, there has never been in our service, either in war or in peace, a strategical or tactical use of our torpedo-boats. The experts in torpedo-boat warfare all agree in declaring that to

be successful the boats must operate in section; the conditions of success for the torpedo-boat section depend upon each boat being at the top-notch of efficiency. Where our torpedo-boat flotilla has been weak is that at no one time have many of our boats been in efficient condition, and but twice have we ever possessed an efficient torpedo-boat section. As successful torpedo-boat warfare must depend upon many efficient torpedo-boat sections, though we possess over fifty of such craft, and though we now have one most efficient torpedo-boat section, our actual torpedo-boat strength measured by what will be war time necessities, is to-day really and actually so small, that it could not be of much effect in bringing a war to a successful termination. This is so because it would take months of preparation to make seven or eight efficient torpedo-boat sections out of our present uncommissioned flotilla.

Let it never be forgotten that, unless their officers and crews are experienced in torpedo-boat duties, the possession of fifty odd craft does not in itself constitute torpedo-boat strength. It may not be necessary to keep constantly all fifty boats in full commission, but that our present torpedo-boat flotilla may be a formidable weapon in case of war, it is respectfully submitted that at all times, year in and year out, there should be some boats in full commission, constantly exercised in section, required not only to develop trial trip speeds, but also regularly to practice at approved torpedo-boat section tactics; and furthermore that those boats not kept in commission should have such constant attention, and be run so frequently, that at all times except when undergoing repairs, they would be ready to be commissioned for offensive work.

The officers and crews attached to these boats should be subject to change after each had received a stated amount of experience with them, thus providing for a healthy interest, knowledge, and experience in such duty throughout all branches in the naval service.

At the close of the war with Spain the torpedo-boats were put out of commission, hauled out of water and laid up. When again called into commission at the close of 1900, it was found that the most extensive repairs were needed by them, and months were consumed in getting the flotilla ready for service. After being commissioned, although the crew of each boat had

some opportunity of learning the special characteristics of its own boat, the highest speeds were rarely if ever attempted, nor was there anything in the nature of approved tactical manœuvres carried out. The mishaps were so constant and so many that each crew was at all times occupied with the interior affairs of its own boat. Real torpedo-boat service was not attempted, and it can hardly be claimed that the commissioning of these boats was of value to the naval service except by the demonstration of needed experience and much drill by those who are to handle them; the boats were so many different units which were not brought together for proper tactical work.

The actual results showed that the great speed powers placed in the boat were not to be developed except by crews drilled into excellence; to attain this excellence requires constant practice for an extended length of time. Another result burned into the minds of all who had to do with these boats was the certain deterioration that always happens to them when not receiving constant care and attention.

At times there has been much discussion in our service of torpedoes and of torpedo-boats, and but very little discussion of the training needed by those who handle these weapons. The purpose of this paper is to examine into the conditions that have prevailed within our torpedo-boat flotilla regarding its ability to perform effectively its designed duty, to inquire if there has been a lack of needed training on the navy's part to handle these weapons efficiently.

As delivered to the navy the torpedo-boat possesses the extremes of speed, destructive power, and vulnerability. Sir William Laird Clowes has said in the NAVAL INSTITUTE'S PROCEEDINGS that the designed purpose and the legitimate duty of the torpedo-boat is "To strike like a bolt from the blue in the most unexpected quarters, to be always in perfect readiness for a few hours of rough, hard work under extreme pressure." The question to be asked is whether the average condition of the boats of our service has ever been such that one might with reasonable confidence of success dispatch them in war time to do their legitimate work. To answer this question, realizing that at times some boats have been kept in commendable states of efficiency, and that the recent work of the section of boats under the command of Lieutenant Chandler has proved that

with opportunity our navy can use these boats intelligently and efficiently for their designed purposes, it must be asseverated that, with the exception of the two sections previously mentioned, our torpedo-boat flotilla has never been in condition for effective work. Although individual boats have at times when long in commission reached commendable states of efficiency, it must be remembered that this is not the final test of their destructive ability. If every unit of our flotilla were in perfect condition, the flotilla would not yet be ready for war, because the torpedo-boat must act in concert with other boats, and much drill and practice is necessary to insure that this will be properly done. As our flotilla of fifty-three boats and destroyers exists to-day, there are but seven, comprising one section, that may be said to be ready for hostile attack. Many more boats could be got ready upon short notice, but officers and crews experienced in torpedo-boat duties could not be found for them; therefore with the exception of one section of seven boats it must be stated that our torpedo-boat flotilla is not in such condition that it could be dispatched in war time on its legitimate duty with reasonable chances of success.

If one examines the history of our torpedo-boats there is at all times evidence that the cause of this is primarily the lack of training in the navy for torpedo-boat work, lack of opportunity for officers and men to learn torpedo-boat duties, and absence of useful torpedo-boat tactical manœuvres during the short periods of time torpedo-boats have been kept in commission. The chief feature of the torpedo-boat is her speed, which is of prime necessity to enable the boat to get within striking distance of her prey before being discovered and destroyed; that this speed is essential to give the torpedo-boat a chance to escape after she has discharged her torpedoes is of secondary importance; the scope of the torpedo-boat's mission does not include consideration of possibilities of escape after the purpose has been accomplished; yet if the personnel of the boat are to be allowed hope of escape this must depend upon the boat's speed. Thus the possibilities of successful attack and subsequent escape all depend absolutely upon the capability of the boat for speed. All navies realize this, and therefore our boats have been designed with this quality in mind, and before delivery to the government the contractor is required by actual trial to prove the speed of the boat he has built.

Many such trials have been made not by the contractor's own workmen, but by an expert torpedo-boat engineer who for the past eight years has devoted all of his time to superintending such trials; he has an expert crew that accompanies him. When engaged for the trial of some particular boat he first devotes himself to drilling his crew into perfect familiarity with the boat in hand, has as many full-powered trials as he judges his crew need, and upon the appointed day he superintends the contractor's trial to meet the government requirements; these trials have usually been successful. It must be remembered that the great speed developed upon such an occasion is the speed that will be actually necessary when the boat is dispatched upon hostile mission,and that without this speed the boat will be destroyed without having a chance to discharge her torpedoes; and all experience proves that this speed will never be developed except by a torpedo-boat crew each unit of which is an expert in his own particular duties.

Naval officers may, with satisfaction, remember that, under continuous commission, we have had boats capable of developing the speed attained on the contractor's trial trips; but where boats have been commissioned after having been laid up, the history is that before being ready for service they have always needed extensive repairs; furthermore the boats were, with rare exceptions, never long enough in commission to permit the units of their crews to become thoroughly expert in individual duties, a fact well attested by the number of accidents incident to the early steaming of the boats, due sometimes to inexperience in handling the boat, and at other times to inexperience in manipulating the engines. This is not surprising; because a naval officer has been graduated from Annapolis and has had several years of watch and other duty, it does not necessarily follow that, when first ordered to torpedo-boat duty, he is as competent to command the torpedo-boat as is the officer who has already had much experience in such duty; nor are the members of the crew as efficient at first as they will be later in the performance of their duties; this though a truism may be pertinent, for it has been seldom that the officer ordered to command has had any previous experience with these craft; the records show that when a boat remains commissioned for some time the ills and misfortunes that always attend the early commissioning of these boats grow more and more infrequent.

The navy is weak in torpedo-boat experience because our boats have been so little used. Hitherto when the boats have been put into commission for the manœuvres, before the officers and crews had had sufficient experience to become expert, the manœuvres were over, and the boats were put out of commission, hauled out and laid up; as previously stated, although the boats are worthless for legitimate torpedo-boat duty unless capable of great speeds, during these short commissions there were too many break-downs at low speeds to justify many attempts at high speeds.

The foregoing remarks apply to the older boats; the faults pointed out are not due to lack of proper spirit on the part of any body, but partly because of the conditions that have existed in the service where there have not been nearly enough officers and men to supply the call from battle and cruising squadrons.

The last addition of these craft to our navy, of sixteen torpedo-boats and sixteen destroyers, are of the latest type, and are possessed of the greatest powers of their class. This addition makes our torpedo-boat flotilla of respectable size and power, although no one would claim that it is as yet sufficiently so for its purpose. But in recent national legislation there has been no apparent tendency to increase the number of torpedo craft.

It is apparent that in the manœuvres soon to be executed in the Caribbean Sea, torpedo-boats will have far greater place than in any previous operations of our navy; and it is probable that the need of many more boats for such manœuvres will be actually demonstrated: this would demand that many of both the commissioned and enlisted personnel receive special training, so that when the flotilla of boats is commissioned either for peace manœuvres or for war, its work will be creditable.

PART II.

Lessons Concerning Torpedo Craft to be Drawn from History and from the Great Foreign Manœuvres.

During the American Civil War the destructive possibilities of the torpedo received terrible illustration, and since then inventors and scientists have been engaged in perfecting this weapon. To-day the Whitehead torpedo is used by all navies, and the

vessels carrying these torpedoes are all built much upon the same plans and considerations. The invention of the torpedo caused the construction of the special vessel to carry it. For many years there was constant study and practice to determine the needed characteristics of the torpedo vessel, and the present form of the torpedo vessel was naturally evolved with the perfection of the torpedo itself and the development of rapid-fire ordnance. The one who studies the history of the torpedo-boat must be greatly impressed by the effect which the great foreign yearly manœuvres had upon its development in size, speed, and number required. The first idea was that the boat should be small and speedy; the great development of small calibred guns made the extreme of speed of prime necessity; without it the boat would never be able to get near enough to the enemy to discharge her torpedoes. A condition early developed by the great naval manœuvres was the need of a vessel designed for the special purpose of destroying torpedo-boats, and thus torpedo-boat catchers of various types were built; following manœuvres proved that all of these types were unsatisfactory, yet in their short-comings was seen the needed characteristics of the boat which was to suppress the torpedo-boat; as a result the torpedo-boat destroyer was built and tried, and has proved to be the instrument needed, and to-day all navies are being provided with torpedo vessels of this class. The development of this weapon has created new problems in warfare, conditions which modern naval commanders must be familiar with, and conditions which are as yet by many officers but imperfectly understood. The foreign naval manœuvres have contributed largely to the development of torpedo vessels, and we have accepted the results of these manœuvres and are building our torpedo craft on the lines indicated by them as necessary. Until the present time we have never had any manœuvres in which the operations of torpedo craft presented any problems or conditions or had the slightest effect. In the British manœuvres of 1901 sixty destroyers and twenty torpedo-boats took part and were in constant activity. The action of these torpedo vessels presented conditions and problems the like of which has never been seen in our navy; foreign navies are prepared to use torpedo-boats in action, and they have studied the best methods of using them strategically and tactically, and of sup-

pressing and repulsing hostile boats. As an offset to this, what have we done? Are we to go on, "hoping that when the time comes to beat an enemy we shall be ready and able to do so by the gift of God which comes to us by steady advancement through the grades of the service?" Manœuvres and torpedo-boat operations have as yet been almost impossible to our service, they will come later; but it is possible to study the foreign manœuvres and to apply some of the lessons there learned to the needs of our own service. In what follows the writer has attempted to quote what was the accepted lesson at the time of torpedo-boat operations, in war and in foreign manœuvres. The views that were expressed at the time are given; some were to be modified by subsequent teachings, some to be repeatedly accentuated. Though there are many officers familiar with the lessons that history and the great peace manœuvres have taught, torpedo-boat operations have been so limited in the past, and are to be so important to us in the future, that it is hoped that the summarizing in one paper of previous torpedo-boat teachings may be of some service. It is not claimed that the views here recorded have other weight than is naturally accorded to capable observers, but it is maintained that these views are those of experts, and that when uttered they were received as correct upon the subject of torpedo-boat operations.

It is held that the purpose of the torpedo-boat is, by operating from a base or shelter, to make hostile attacks upon the enemy's ships; and that the purpose of a destroyer is, in addition to its character as a torpedo-boat, to prevent torpedo-boat attack, to destroy and suppress torpedo-boats, to blockade torpedo-boats, to accompany squadrons to sea and to keep up with them at high speeds in all weathers for long distances.

We have made but little use of our torpedo-boats either in war or in the few peace manœuvres we have had, but we now have a large number of such craft, and we have officers and men enthusiastic of their possibilities; as real earnest intelligent use of them is almost new to all but a few of us, let us see how we can apply to our own circumstances the lessons that have been learned concerning them.

The real conclusive lesson will be taught only when great powers war; still the torpedoes have been used in little wars,

and from these we may learn something; and the foreign manœuvres have developed much knowledge concerning torpedo-boat operations and dispositions.

THE CHILIAN REVOLUTION OF 1891.

The torpedo-boat in its present modern form was first used in hostile attack on April 23, 1891, when the Chilian government vessels, Lynch and Condell, attacked with their torpedoes the Revolutionary vessels in Caldera Bay; five torpedoes were discharged, only one of which struck its target; this one sunk the Blanca Encalada. The official report of this action said that the lessons this taught were:

> "The difficulty of effectively using the Whitehead torpedo save when it is in the hands of people thoroughly familiar with it, and the untrustworthiness of the human element in torpedo warfare.—The usefulness of the Whitehead torpedo when properly employed.—To use any torpedo effectively even in peace time requires not only coolness and self-command, but also great carefulness, and above all, training."

Target practice with the Whitehead torpedo as then supplied, everywhere proved the uncertainty of the direction that the torpedo would take after launching; that one out of five torpedoes discharged should hit its target was at that time to be considered good torpedo marksmanship; during our recent manœuvres the torpedo-boat section commanded by Lieutenant Chandler, running at full speed discharged 14 torpedoes, 12 of which struck their targets. The invention of the gyroscope has converted the torpedo from a weapon of most uncertain aim to one of gun precision. The certainty of aim with which the torpedo can now be discharged bespeaks for it a far greater field than when, ten years ago, it was so uncertain.

THE CHINESE-JAPANESE WAR, 1894.

The great lesson to be drawn from the torpedo-boat operations of this war is the utter worthlessness in accomplishing results of the weapon when operated by untrained crews. At no one time were the boats operated with the best strategical or tactical considerations. At the battle of Yalu, on September 17, 1894, there were no Japanese torpedo-boats, and the Chinese boats present, if there were any, took no part in the fight. At Wei-Hai-Wei the position of the Japanese invited

torpedo-boat attack, but none was made upon it. Here, on January 30, 1895, sixteen Japanese torpedo-boats attacked the Chinese fleet, but failed in accomplishing anything. Later, on February 5, these boats repeated the attack upon the Chinese fleet, then crippled and disheartened, and sunk several ships.

THE BRAZILIAN REVOLT OF 1893-94.

During this conflict torpedo-boat operations had place but once, which was at the close of the revolt. Two separate attacks were made by four government torpedo vessels upon the Aquidaban, on the nights of April 4, and April 5, 1894. On the second night, one of four torpedoes discharged, struck and sunk the Aquidaban.

THE SPANISH-AMERICAN WAR OF 1898.

There were no torpedo-boat operations worthy the name in this short war. The American boats were used for everything except torpedo-boat work. Apparently the Spaniards had not the faintest conception of the proper use of their destroyers, which were at all times a positive hindrance. In action they were vanquished by a converted American yacht. The attempted attack of the Terror upon the St. Paul was made in the greatest of ignorance, and of necessity ended in disaster.

Let us turn from the limited torpedo-boat operations in warfare to what has been done in the great naval manœuvres.

The tremendous possibilities of the torpedo-boat has for years appealed to naval minds, and in the evolution of the type it is interesting and instructive, from the point of view of present knowledge, to examine into the expressions of those who had to do with the weapon in its earlier days.

A French student whose views were widely read and discussed wrote in L'Année Maritime, in 1882, that:

> "A condition essential to the success of these weapons is that they should be manœuvred by bold, well-disciplined crews, free from liability to panic, and composed of men resolutely determined to sacrifice their lives if necessary."

Some features of the torpedo-boat have undergone much development, but the character of the men who are to man them must always be of the nature just quoted; this is accentuated by every employment the weapon has ever had, in peace and in war.

In July, 1879, in the Revue Maritime, Lieutenant Chaubaud-Arnault of the French Navy, presented a paper on the subject of "The employment of Torpedoes in boats against ships." One of the views presented in this paper, drawn from a study of all previous torpedo-boat operations, is:

"An attack attempted by night or day by a well-constructed torpedo-boat presents no exceptional dangers either for the boat or the crew."

This most remarkable statement which to-day is absolutely untenable, is a forcible illustration of the great development of the torpedo-boat and of the means of repelling torpedo-boat attack. In present times attacks from torpedo-boats would never be attempted by day by experienced officers, and an attack by night by single boat would be made only as a last despairing attempt, almost hopeless of success, and entirely hopeless of returning whole from the attack except if the enemy be entirely unprepared.

In Vol. VII, No. IV, of the Mittheilungen aus dem Gebiete des Seewesens, is found the report by Lieutenant Witheft of the Russian Navy, of the results accomplished at the Russian Naval Torpedo School, in 1879. Throughout the summer of 1879 twelve Russian torpedo-boats in full commission had been constantly exercised for the purpose of studying and developing the best methods of handling torpedo-boats. The following were among the conclusions reached:

"Boats must be manned by men trained to the hazardous duties expected of them."

"The torpedo and the torpedo-boat should form a single weapon so that the attention of the officers in command may never be divided between the conducting of the boat and the handling of the weapon."

"Every division of torpedo-boats should be trained to conduct an attack without the support or cooperation of any other naval arm."

"In the Russo-Turkish war almost every attack was successful when undertaken according to a well-matured plan by a group of boats, and no attack succeeded which was made by a single boat."

"Attacks by single boats are only to be attempted as a last resource."

"The attack must be made according to a carefully considered plan."

"The attacks should be made at a signal from the officer in command, simultaneously from several points."

"In order to be able to apply all these rules effectively in war, it is necessary in time of peace to train every torpedo division to act as much as possible under the conditions which would arise in actual warfare. It is only after much practice that success can be obtained in this new method of warfare. Trials with single boats can only be

regarded as preliminary to manœuvres with a whole division. The only way to insure success when a boat is for the first time attached to a division, is constant practice in making attacks of a similar nature in time of peace."

In an essay by Commander Hayes, of the British navy, published in the Journal of the United Service Institution, Vol. XXII, 1878, it is said:

"Torpedo-boats attacking a ship at anchor will probably have to oppose two lines of obstructions, and to engage other torpedo and guard boats; they would also be exposed to a severe fire from rifles, Gatlings, grape, and case, directed by the aid of the electric light; therefore torpedo-boats should attack in numbers and from different quarters."

In a speech in the British House of Commons, in 1877, Commander Lord Charles Beresford said:

"If three or four boats of great speed attacked a ship from different points of the compass, the ship was doomed to destruction. Great Britain might build enormously powerful ships, but torpedoes must be the order of the day."

In his report of 1878-79, Admiral Porter said:

"The history of torpedoes shows a large proportion of failures and the destruction or imminent risk of the boats employed."

In presenting these views of early torpedo-boat students, the writer does not offer them as possessing any peculiar sanctity nor value, except as they applied at the time they were written.

But it is interesting and instructive to know the influences upon our predecessors in torpedo-boats, and where we find certain principles, the truth, the pertinence, necessity, and value of which are constantly and increasingly accentuated, we may with profit study them and apply them to our own circumstances.

Let us follow the history of torpedo-boats in the yearly manœuvres of the great naval powers.

In the British naval manœuvres of 1885, twenty-five torpedo-boats took part. That part of the report which concerns these boats states that about half of these became disabled during the passage from their home ports to the scenes of the operations; a great action was planned in which these boats were to have a prominent part in the attack; the report of the attack says that these torpedo-boats seemed to be uncontrollable; many collisions occurred, machinery mishaps, and break-downs of disabling nature were more than frequent, and when the order

for the atack was given but few of the 25 boats could take part. The judges reported their opinion of these torpedo-boats to be that in their condition and as they were handled, the torpedo-boats could not have succeeded in any attack.

In 1885, Lieutenant Leroy, of the French navy, brought a section of torpedo-boats from Brest to Toulon; in his report to the Ministry of Marine of this passage, he says:

> "That which is wearying on board a torpedo-boat, and is extremely trying to a sensitive nervous system, is the continual vibration and racing of the engines with a violence which almost suggests that the engine must come to pieces. The strain is moral rather than physical, but it tells upon the whole system; after a short time, however, one grows used to it. With the engines all was satisfactory; the engineers were accustomed to torpedo-boats. They were men who had training at Brest. It is absolutely necessary that the crew of a torpedo-boat should be thoroughly accustomed to this class of vessel."—(Brassey's Annual, 1886.)

In Brassey's Annual of 1887, a writer criticising the torpedo-boat work of the previous manœuvres, says:

> "The introduction of the torpedo, the torpedo-boat, and the torpedo-boat catcher, calls for the creation of a special service for the efficient manning of the coast defence flotilla. A school of training for this purpose is not less necessary than a school of gunnery."

Torpedo-boats took a prominent part in the French naval manœuvres of 1886. A very prominent illustration of the character of their service is shown by the difference between the first and the last reports. We find at first that a short cruise of 27 hours so completely used up the crews of these boats that they were reported to be completely unfit for duty.

Some months later these same crews were found to be able to handle their boats for weeks at a time, in even worse weather, without exhaustion. The lesson here portrayed has been emphasized by the history of every torpedo-boat that has ever been put into service. Exhausting though torpedo-boat work is, with a few months of training the crews can accustom themselves to the physical demands upon them without overstraining themselves. In these manœuvres off Toulon, torpedo-boats at first made themselves notorious because of the number of boats that were sunk by avoidable collisions; also the machinery mishaps were so many that no boat could be depended upon to execute a signal. In an attack upon a hostile fleet that appeared

off Ajaccio, of twenty torpedo-boats that were formed for attack but six were in condition for service. Later, at the same place, a fleet of thirteen boats, the slowest of which had made over a trial course a speed of twenty knots, sallied out to attack a hostile squadron, which, after seeing the fleet of boats start out, steamed away at a speed of 11½ knots; the fleet of torpedo-boats was not able to catch up to this squadron. After some months of work the troubles that had early beset these boats had mostly disappeared, and the boats were found to be capable of effective service. In the report concerning these torpedo-boat operations is found the following significant statement:

"The experience gained during two months of constant torpedo-boat work was noticeable in the increased skill and endurance shown by the crews of all the boats."

"A special class of men must be trained for service in torpedo-boats, for, with increased experience in the crew the increased efficiency of the boat is very marked." (Brassey's Annual, 1887).

It is certain that, if our boats are to be commissioned only when war breaks out, nothing but misfortune and disaster will attend them; they will surely suppress themselves without harming the enemy; it is too much to hope that there will be any possibility of practice with them after the declaration of war. To be of any service the boats and crews must be drilled beforehand, must be ready to face the problems and conditions that war brings. All experience shows that torpedo-boats put into service without drill can never accomplish anything, while the possession of numerous well-drilled boats will prevent a possible enemy from ever attempting to sight our shores.

The French navy learned this lesson so well that, previous to their manœuvres of 1888, forty torpedo-boats with crews numbering 1722 men were kept in commission for a year. The work done by torpedo-boats during these manœuvres was not entirely satisfactory, but it was a great improvement over what had been done previously. In the French manœuvres of 1889, the record of the torpedo-boats was marred by collisions with other boats and by machinery mishaps; it was reported that in all of such cases these troubles occurred to boats whose crews had had no torpedo-boat training, and that they were caused by inexperience. The great lesson learned by the French from these manœuvres was the necessity of previous drill at torpedo-

boat tactics; before this each section-commander had used his boats according to his own particular judgment, the best methods of handling a number of boats acting together had not received much study, and the necessity of tactics was but dimly appreciated; there being no well-developed agreed-upon system of tactics; each commander used his boats in an attack with but little knowledge of the best methods; confusion always occurred, the attacks were rarely successful, and the boats suffered terribly. The certainty of success by the German method of attack, as recently shown by Lieutenant Chandler, is an illustration of what has been accomplished in the methods of using this weapon by constant study and practice with it. In 1889, there was much difference of opinion of when and how and where this weapon should be used; every year's work since then has thrown light upon this subject, and the yearly operations have worked out many torpedo-boat problems.

The following is an extract from the report to the British Admiralty of the naval manœuvres of 1888 (Brassey's Annual, 1889):

"Torpedo-boats would be of far more use to the blockaded squadrons than to the blockaders. Torpedo-boats, if not capable of keeping the sea independently under all conditions of weather, would inevitably prove a cause of embarrassment and anxiety to an admiral commanding a blockading fleet, and would be subject to endless casualties."

"The employment of torpedo-boats as an inner line of blockade is not desirable, they being calculated to cause much confusion and embarrassment to their friends; they are admirably adapted for purposes of defense; but even then without a very simple and perfect system of signals they are liable to be mistaken for enemies by their own side. This occurred once at least on each side during the 1888 manœuvres."

The following is an extract from the parliamentary report of the British manœuvres of 1890:

"The radius of action of a torpedo-boat is limited less by her coal and feed water supply than by the physical endurance of her crew, especially her commander." (Brassey's Annual, 1891.)

Criticising these same manœuvres, a writer in Engineering, in 1890, said:

"We now come to the principal lesson from the naval point of view, and that is the great value for training purposes such service has to young officers whose future will be entirely cast in steam vessels. It would appear in every way desirable that a certain period in a torpedo-boat should be an essential part of a naval education. To carry this

into effect a proportion of the boats should always be kept in commission at the various ports, the remainder to be kept in reserve, and to replace periodically those which require refit or repair." (Brassey's Annual, 1891.)

Writing in Le Yacht of these same manœuvres, the well-known French critic, M. Wehl, said:

"The English manœuvres have shown once more that torpedo-boats well handled are formidable weapons at a small distance from the shore."

THE BRITISH NAVAL MANŒUVRES OF 1891.

These are the most important manœuvres as regards torpedo-boats that have ever taken place. The British Admiralty announced to the squadrons mobilized for the manœuvres the following tasks:

"(a) To ascertain the tactics which would probably be adopted by flotillas of torpedo-boats stationed at several points on one shore of a channel in order to harass or destroy an enemy's ships on the other side."

"(b) To ascertain the measures which should be taken to give security against the attacks of these torpedo-boats."

Discussing the results of these manœuvres the well-known naval critic, Mr. Thursfield, wrote in the Quarterly Review of April, 1892:

"The bases assigned to the torpedo-boats on this occasion were the Irish ports of St. George's Channel. Their objective was a small squadron of ironclads with cruisers and torpedo-gunboats under Captain Long, with his base at Milford Haven, and a freedom of range throughout the area accessible to the hostile torpedo-boats, Captain Long, himself a torpedo expert of great experience and capacity, resolved to make his defence an active rather than a passive one, that is, instead of entrenching himself behind such fixed and mobile defences as are available when a squadron remains at its anchorage, and waiting for torpedo-boats to attack him, he went himself to attack the torpedo-boats. The result abundantly justified the tactics employed. In no one single instance during the operations was a torpedo-boat successful in its attack on an ironclad. Of the twenty boats engaged, four were adjudged to have been captured, while seventeen separate attacks delivered by the remainder were adjudged to have resulted in the temporary disablement of the boats engaged. Besides this, two of the protecting ships attached to the torpedo-boat bases were destroyed by Captain Long, and the end of the operations left him completely master of the situation."

These 1891 manœuvres are of especial interest to the student of torpedo-boat warfare because they were, by intent and in

act, a direct duel between torpedo-boats and an attacking squadron. Of this, Mr. Thursfield wrote in Brassey's Annual, 1893:

> "The object of the torpedo-boats was to harass the squadron, to impede its operations, and to destroy it if possible; while the object of the squadron was, by clearing the sea of torpedo-boats, to recover its freedom of operation, and, in the meanwhile, to take effective measures for its defence against their attack."

The striking lesson taught by these operations is that the best defence against expected torpedo-boat attack is made by assuming the offensive against them, and until in readiness for such offensive action, to keep out of the torpedo-boat's radius of action. If the torpedo-boats are not met with, the squadron should destroy if possible the bases of the torpedo-boats; this will effectively suppress the boats; if these bases are ports that cannot be destroyed, the squadron watching outside will be sure to catch some of the boats attempting to run the blockade, for the torpedo-boat must have frequent recourse to its base. All war manœuvres have proved that it is almost impossible for torpedo-boats to find an enemy's ships that are somewhere at large upon the sea, and also that a squadron can surely find the hostile torpedo-boats by watching their bases; this insures the suppression of the boats though it invites attack from them. In the manœuvres of 1890 a squadron anchored at a distance of over 100 miles from where there was known to be torpedo-boats; a night attack was made by the latter and four great battleships were destroyed; in the operations of the next year the squadron was constantly on the move, searching for the boats, well prepared for the attack which it invited; seventeen different attacks were made upon it, with the result of the destruction of all of the boats making the attacks, the squadron being entirely uninjured; the report concerning the torpedo-boat operations of these 1891 manœuvres was (Brassey's Annual, 1893):

> "A torpedo-boat attack to be successful must be in the nature of a surprise. The torpedo-boat has a wider range of offensive action than was before believed. Properly handled, torpedo-boat attack may always be frustrated by torpedo-boat destroyers."

In 1890 the torpedo was most uncertain in its aim, the boats were slow compared with those of to-day, the vaguest ideas of best methods of using the boats existed, and yet, though always made in the greatest of confusion, torpedo-boat attacks some-

times were terribly destructive. Since then the torpedo has become a weapon of precision, the speeds of the boats approach thirty knots; modern warships are specially prepared to repel successfully torpedo-boat attack; all of this imperatively demands from our officers and men a knowledge of these new features of naval warfare.

The British naval manœuvres of 1892 continued the investigation of problems of torpedo-boat warfare. Here the particular problem was to investigate the effect of torpedo-boat menace or attack under different circumstances.

Two squadrons of the same flag were to meet and effect a juncture in narrow waters; between them was a powerful hostile squadron, accompanied by a formidable force of torpedo-boats. Criticising these operations, in Brassey's Annual for 1893, Mr. Thursfield said the operations showed that:

> "The dreaded torpedo-boat can be completely neutralized by a tactical menace analogous to that which it exerts itself; its own menace is nevertheless so potent within its effective sphere of operations as to interpose impediment to the free movements of the immensely powerful squadrons which might completely frustrate the combinations and defeat the purposes of a deep-laid plan of campaign. The security of a cruising fleet at night against the attack of torpedo-boats in waters open to their operations lies in its constant movement at a speed and in directions not known to the enemy in search of it. It is certain that the menace of the torpedo-boat operates with immense effect on the cruising fleet. No one who realizes the immense importance of time in the operations of modern warfare will think it a small matter that the junction of two fleets immensely superior to the adversary opposed to them was delayed for 48 hours by the comparatively insignificant force of 21 torpedo-boats, and that this effect was produced although the torpedo-boats never succeeded in destroying a single one of their adversaries."

Torpedo-boat operations formed a part of the French manœuvres of 1892; it was reported that the great lesson taught by them was:

> "The absolute inefficiency of torpedo-boats as auxiliaries to a sea-going iron-clad squadron." (Brassey's Annual, 1893.)

Both the French and Russian manœuvres of 1891 consisted of attacks by hostile squadrons upon the coasts defences, among the latter being many torpedo-boats. The lesson taught by these operations was the intimidating effect upon an admiral by the presence of hostile torpedo-boats. The apprehensive watch-

ing for them proved to be the most wearing strain that had ever been imposed upon the officers and crews of these ships. A few days of it used them up. If this is so in peace manœuvres, what is to be expected in war? If it be imperative that a squadron gain foothold on a hostile shore, the torpedo-boats of the latter must first be suppressed, and all experience shows that the squadron should assume the offensive against them rather than wait for attack; these manœuvres again proved that, though the torpedo-boat under proper convoy can make long voyages, in war time it is not a sea-going instrument of naval warfare.

As these yearly manœuvres proceeded, it is seen that each year questions concerning the possibilities of torpedo-boats and the best means of repelling attacks from them formed the great problem; on the part of Great Britain we always find great squadrons opposed to each other, and great numbers of torpedo vessels present. The simulated conditions generally are those of Great Britain opposing the combined forces of France and Russia. Great Britain is more powerful in battleships and cruisers, while France and Russia possess a far greater number of torpedo-boats. Naturally the purpose of many of the foreign manœuvres has been to decide to what extent the opposing superior force of torpedo-boats counterbalances the inferiority in fighting ships. In investigating this question all sorts of problems connected with torpedo-boats have been met with, and much knowledge has been gained which we can apply to our own necessities.

Many of the French and Russian manœuvres consisted in attacks upon their coast by superior squadrons, to be opposed by inferior squadrons accompanied by great numbers of torpedo-boats.

In the British manœuvres of 1893, two powerful fleets in a narrow channel were opposed by a slightly inferior fleet, but which possessed a far greater force of torpedo-boats. The particular question laid down by the Admiralty was to ascertain to what extent this great superiority in torpedo-boats redressed the slight inferiority in fighting ships. During these operations there were fleet actions and constant torpedo-boat attack. The latter were handled by determined officers and experienced crews, ambitious to prove the decisive value of the torpedo-boat as a weapon; they properly took great chances. As a

result of all of these torpedo-boat attacks, one battleship and four cruisers were sunk, but this was at a cost of five cruisers and twenty-seven torpedo-boats, in five and a half days. The results of these operations are summed up in Brassey's Annual, 1894, by Mr. Thursfield, as follows:

"Thus the continued experience of three years' manœuvres, those of 1891, 1892, and 1893, would seem to show that the sea-going torpedo-boat is an overrated weapon of defence. In 1891, the late Admiral Long showed 'that an active defence, adequately organized and skilfully disposed, must in the end completely neutralize the offensive capacity of the torpedo-boat.' This demonstration was reinforced by the manœuvres of 1892, which also showed further that the extinction of the torpedo-boat menace follows immediately on the destruction of the shelter provided for the hostile torpedo-boats, and on the surrender of the sea-going squadron to which they are attached as auxiliaries. Lastly, the manœuvres of 1893 completed the demonstration, showing that, even in default of an active defence adequately organized and skilfully disposed, torpedo-boats are very apt to suppress themselves and to attain a very high rate of extinction in the normal course of their attacks on a powerful and vigilant sea-going adversary. The truth seems to be that a torpedo-boat ought properly to be regarded not as an independent sea-going unit of naval force, but as a peculiar and very destructive kind of projectile with a very extreme range which varies according to circumstances, but is by no means unlimited in any circumstances, and with an intelligent power of altering its direction in the course of its flight, but also with a considerable liability to be destroyed or intercepted before it attains its mark. As such its menace is tremendous, and its influence upon all strategic dispositions within its range is dominant and decisive so long as its menace is unabated. But experience, now repeatedly tested in our own and other navies under conditions as closely analogous to actual warfare as peace manœuvres can be made to afford, would seem to have shown that its strategic menace is far more formidable than its real offensive capacity, and that regarded as a projectile it is endowed with a really remarkable capacity for hitting wide of the mark, and destroying itself before it has delivered its blow, to say nothing of its very awkward habit of occasionally mistaking a friend for an enemy."

THE BRITISH NAVAL MANŒUVRES OF 1894.

The following is an extract from the official report made of these manœuvres. It is found in Brassey's Annual, 1895.

"The torpedo-boat operations were upon a too-restricted scale to supply much valuable instruction, but, as far as they went, they tend to confirm the view that the most effective employment of the torpedo-boat in war will be limited to sending her to attack an enemy's ship in a known position within the torpedo-boat's range of action, and that

the whereabouts of the enemy must first be ascertained and communicated to the commander of the boat."

"The necessity of combining with torpedo-boats, vessels of other and larger classes to scout and discover an enemy, where exact information as to his position can not be obtained by other means, seems to be established, and if so, it carries with it the obligation to consider a mere flotilla of torpedo-boats by themselves as a belligerent factor of distinctly imperfect efficiency."

The effect of these manœuvres was to make the British naval officer more familiar with the limitations of torpedo-boats. It has been repeatedly demonstrated that unless the torpedo-boat knows just where to find the enemy it will probably miss him. Torpedo-boat attack can be successful only in the darkness of night, and for the boat, time is a most important factor. These boats have repeatedly mistaken friends for foes with disastrous results to their own side.

THE BRITISH NAVAL MANŒUVRES OF 1895.

The manœuvres of 1891, 1892, 1893, and 1894, dealt mainly with strategical questions; in these years torpedo vessels were assigned most prominent parts; in some of these manœuvres the main problem proposed concerned the proper disposition and use of torpedo-boats. During these operations the need of tactical torpedo-boat exercises became more apparent each year, and as a result the manœuvres of 1895 were entirely tactical in nature. The torpedo-boat squadron was organized, and the boats comprising it carried out the following tactical manœuvres (Brassey's Annual, 1896):

(1) Ordinary cruising at various speeds with tactics, to accustom officers and men to the handling of their vessels and boats and their armaments.

(2) Spreading for scouting work and reforming.

(3) Target practice at high speeds and special targets.

(4) Torpedo practice at high speeds.

(5) Tests of capabilities of destroyers in blockading torpedo-boats.

(6) To ascertain how far the best torpedo-boats could prevent modern ships of war from using a channel with the opposite coast in the enemy's hands, and the value of destroyers as a protection to such ships.

(7) To ascertain to what extent it would be desirable to use destroyers as sea-going boats.

THE BRITISH NAVAL MANŒUVRES OF 1899.

One of the objects of these manœuvres was announced to be:

"To obtain information relative to the workings of Destroyers and Torpedo-Boats."

Twenty-eight destroyers were assigned to one of the fleets and twenty-four torpedo-boats were assigned to the opposing fleet.

The results of these manœuvres are summed up in Brassey's Annual of 1900, as follows:

"The chances of a torpedo-boat finding a single ship or even a fleet in the course of a roving search have been proved over and over again in manœuvres to be exceedingly small, and they are reduced almost to zero by the presence of a vigilant and active flotilla of destroyers within the area of search."

In these manœuvres the squadron that was the inferior persistently avoided action and its opposing squadron could not find it. It was held that during the manœuvres the torpedo craft were not strategically placed, and no great lesson concerning them was to be drawn from these operations.

THE BRITISH NAVAL MANŒUVRES OF 1900.

One of the three objects of these manœuvres was announced by the Admiralty to be to obtain information relating to:

"The power which cruisers may or may not possess of hunting down and driving torpedo craft into port."

The following are extracts from a criticism of these operations, to be found in Brassey's Annual, 1901:

"The destroyers proved singularly useful as scouts for certain purposes, such as the examination of the enemy's anchorages and possible shelter places, and as fast messengers. As a menace the destroyer is exceedingly formidable, indeed against torpedo-boats its menace is little short of a positive deterrent; as a messenger and for certain purposes as a scout, it is within certain limits almost invaluable."

THE BRITISH NAVAL MANŒUVRES OF 1901.

These were the first manœuvres in which many destroyers were assigned to each of the opposing squadrons. One of these squadrons was composed of 12 battleships, 25 cruisers, 32 destroyers, and 10 torpedo-boats. The opposing squadron was

composed of 8 battleships, 24 cruisers, 28 destroyers, and 10 torpedo-boats. The number and the power of the torpedo craft engaged in these operations illustrates the increasing importance attached to this weapon in naval operations. These torpedo craft were in full and constant activity, attacking and eluding ships. Mr. Thursfield criticises these operations in Brassey's Annual, 1902, as follows:

"Of the manœuvres as a whole it may be said without hesitation that they were full of pregnant instruction and fuller still of not less significant warning. The question was asked in The Times at the close of the manœuvres, 'Have we nothing to learn about the art of scouting, about the strategic planning of a campaign, about the true relation of the destroyer to the battleship, alike in attack and in defence, in a word about the training of the naval officer for battle?' In the handling of destroyers and other torpedo craft, again, it cannot be denied that our admirals and senior officers have a great deal to learn. They must make up their minds as to what these vessels can do and what they cannot, how they can be employed to the best advantage, whether they are to be scouts, or commerce destroyers, or torpedo craft proper. Above all they must learn to establish some rational relation between the menace they can properly exert and the injury they are likely to inflict. It is hardly too much to say that the menace of the torpedo craft opposed to him was at the bottom of all Admiral Noel's dispositions, and indirectly the cause of his discomfiture. The actual injury they inflicted upon him was the loss of a single second-class cruiser. On the other hand, it is not perhaps hazardous to conjecture that the employment by Admiral Wilson of his destroyers in the rather burlesque performance of pretending to 'stop the trade,' was the veil of a crafty tactical purpose. By keeping them behind him he prevented their attacking him by mistake, and could safely open fire on any destroyer he saw, with little or no fear of her turning out to be a friend. But this is as much as to say that the destroyer as an element of naval force has not yet been co-ordinated with other elements, a practical proof that the true relation of the destroyer to the sea-going ship has not yet been determined. There is perhaps no outstanding problem of naval organization and tactics which presses more urgently for solution than this, none of which the solution is fraught with larger or more momentous consequences."

PART III.

Torpedo-Training in Foreign Navies.

Torpedo instruction in the British Navy.

The following is learned from the publication entitled:

"Course of instruction of officers and men in the torpedo schools. By authority of the Lords Commissioners of the Admiralty."

The instruction in torpedoes and torpedo-boats in the British Navy is most elaborate. It includes seven different courses for commissioned officers, four for warrant officers, nine for artificers of various grades, four for petty-officers, and two for seamen.

These seven courses for officers are as follows: The first course is the "Special full pay torpedo course." It is for officers who have already qualified as Gunnery or Torpedo Lieutenants. It is an advanced course for officers who have been especially selected to take it. This course of instruction lasts for sixty-five working days, twenty-five of which are completed before the yearly manœuvres, and forty after them.

The first twenty-five days is devoted to what is known as the "Whitehead Course." This is subdivided into two parts, the first part of seven days is devoted to theory, and the second part of eighteen days is devoted to practice. The mornings of these first seven days are spent in hearing lectures on the torpedo armaments of vessels in the navy, and on torpedo mechanism. The afternoons following these lectures are spent in making the various adjustments to the torpedo mechanism to prepare the torpedo for a run. After these seven days comes the practical course of eighteen days, which consists of running torpedo-boats and destroyers, exercising them in different ways, with constant torpedo target-practice at moving targets, combined with practice at such tactical manœuvres as would be used with these craft in war time.

After this Whitehead Course it is probable that many of the officers taking it command the torpedo craft that take part in each year's manœuvres.

At the conclusion of the manœuvres the second part of this "Special full pay torpedo course" takes place. This is known as the "Electricity and mining course;" it lasts for forty working days. For the first twenty-two days, each day's work commences with a lecture, which is followed by practical work for the rest of the day. The lectures of these twenty-two days are devoted to the instruments of various kinds used in torpedoes, in gunnery, and in electricity, to their use, manipulation, care, and repairs; to cables, detonators, fuzes, primers, tubes, and dynamo exploders; to explosives and defensive mining; to attacks on harbors, sweeping and countermining, and to block-

ade mines; to wireless and submarine telegraphy; to defense against torpedoes and torpedo-boats, booms, nets, obstructions, etc.; to dynamos, motors, and search lights. Immediately after each lecture the officers present engage in practical work upon the subjects that were under consideration in that lecture. After these twenty-two days come eighteen days of practical work in which harbors are mined and countermined and cleared, impromptu defenses against expected attack are set up, different problems incident to this subject being worked out.

This course of sixty-five days is intended to be an advanced course of instruction of the highest character in torpedoes, electricity, and mining, for a few officers specially selected to take it.

The second course for commissioned officers is known as: "Special course of instruction to qualify as torpedo lieutenants." This course lasts for twenty months. The officers who after undergoing this course pass the required examinations are said to qualify as "Torpedo Lieutenants." The first eight months are spent at the Greenwich Naval College, studying principally the theory of electricity and chemistry. The remaining twelve months are devoted to studies supplemented by practical work in torpedoes and torpedo-boats, electricity and wireless telegraphy, gunnery and marine surveying. It is intended that at the end of these twenty months the officers who have undergone this course shall have become expert in all torpedo adjustments, in handling the torpedoes and torpedo-boats, in the knowledge of when and how and where to use them; in electricity as applied to naval purposes, in the knowledge of explosives, and of the various subjects necessary and akin to the proper use of the torpedo. The intent and effect of this twenty months' course of instruction is to prepare young officers for their duties aboard torpedo-boats and destroyers during the manœuvres and at other times, and in charge of the torpedo equipment aboard warships so provided. The Torpedo Lieutenant ordered to a ship has charge of all torpedo equipment and fittings, and all electrical generators and motors and fittings, and is responsible for their condition. He carries out the various torpedo exercises ordered by the admiralty; he gives every opportunity for instruction in torpedoes and electricity to untrained men; he acts as adviser on torpedo subjects to his

captain; he must keep informed of foreign and home methods of harbor defense, and have a knowledge of the mine fields of British harbors. Before action he advises the captain of how the torpedoes should be worked, and he personally fires the torpedoes.

The next course is the "Course for Senior Officers." This is held in the spring of each year, and lasts for twenty working days. The first nine days are devoted to the study and consideration of service torpedoes, to making the necessary adjustments, to launching the torpedoes from destroyers underway, and to net-cutting experiments. The following nine days are spent in hearing lectures on electricity in its different naval applications, including wireless telegraphy, in naval mining, on the defense and attack of harbors, and in practical work in connection with these subjects.

The next course is the "Lieutenants' short course, and Officers R. M. A." This is for officers of the Royal Navy, The Royal Marines, The Royal Naval Reserve, and the Royal Indian Marine. The course is for forty working days, in which the torpedo is studied, and the adjustments are made, and torpedo target practice is had from destroyers underway at moving targets. Harbors are mined and countermined and cleared; the naval applications of electricity are studied practically.

The next course is the "Course of instruction for Retired Officers." This course consists of twenty-five working days, and is the same as that for Senior Officers, with the addition of two extra days for running Whiteheads and three days Practical Mining.

The next course is the "Course for Acting Sub-lieutenants," and it consists of twenty-five working days. The instruction is divided into two parts, the first lasts for ten days, and is devoted to "General Torpedo Work," in which the young officer is made familiar with explosives, and methods of detonating. The time is principally spent in making tests, in looking for leaks and faults of the electrical connections and in repairing them. The second part of this instruction is called the "Whitehead Course," where the young officer is made familiar with the torpedo and all of its adjustments; he is practiced at running torpedoes from destroyers, and in the management of torpedo-boats. In the latter practical instruction is given in the use of

the helm, steering, leaving and coming alongside a dock, handling the boat in confined waters, picking up buoys, methods of attacking ships at anchor and underway, and making attacks in company with other boats.

The next is the "Course for all Engineer Officers" which lasts for seven weeks, five weeks of which are spent in studying and adjusting and practicing with the Whitehead torpedo, and the two weeks following are spent in studying and practicing with the electrical instruments used for naval purposes.

TORPEDO INSTRUCTION FOR WARRANT OFFICERS.

Candidates for Gunners, who are already Torpedo Instructors, are required to go through what is called the "Special Torpedo Course for Gunner (T.)." Men who are not Torpedo Instructors when selected to qualify for Gunner (T.) will be required to qualify for that rate, and, if considered suitable will be allowed to go on with the Gunners' Special Torpedo Course.

This course lasts for 100 working days, the first 60 of which are spent in studying mensuration, logarithms, and trignometry; the next 40 days are spent in working with electricity, torpedoes, and signals. On completing this Torpedo Course candidates are required to go through a Gunnery Course lasting 126 days.

Candidates for Gunner (G.) are required first to take the course of 60 days to qualify as Seaman Torpedo Man, unless they have previously qualified in this course, and then they proceed with the "Special Torpedo Course," which lasts for 80 days, and which is principally devoted to practical work with torpedoes, electricity, and signals.

TORPEDO INSTRUCTION FOR ENGINE ROOM ARTIFICERS.

Men of these ratings are required to go through an eight weeks' course of practical instruction in the torpedo shops, making adjustments and repairs, followed by five weeks' practical work in the electric light shop, doing such work as is incident to the naval use of electricity.

In the British Navy there is a special rate called "Torpedo Instructor." Men holding this rate are carefully selected by the Captain of the Torpedo School, and must qualify in a prescribed course of studies and practical work that takes 167 working days, 40 days of which are spent in studying arithmetic, and the re-

mainder of the time is devoted to torpedoes, electricity, and signals.

To qualify as Chief Armourer the candidate is required to undergo a course in studies and practical work in torpedoes and electricity that lasts for 155 working days; before a man can be rated "Armourer," he must have had special instruction for 30 days in torpedoes and electricity, and the workshop.

TORPEDO COXSWAINS.

Coxswains of torpedo-boats are selected from Petty Officers (1st class) who are Seaman Torpedo Men. They are required to undergo instruction for 85 working days in torpedoes, management of torpedo-boats and destroyers underway, torpedo target practice at moving targets, internal organization of torpedo-boats; the care and maintenance of such batteries, circuits, and searchlights as are found in torpedo-boats, messing, accounts, etc. Of these 85 days, 30 days are spent in the handling of destroyers under varying circumstances.

COURSE OF INSTRUCTION TO QUALIFY AS LEADING TORPEDO MEN.

A certain number of Seaman Torpedo Men are selected to undergo instruction to qualify as Leading Torpedo Men. This course lasts for 86 working days, in which the following subjects are studied: Torpedoes, theory, adjustment, and use. Practical work with the electrical fittings to be found upon torpedo-boats. Signals.

COURSE FOR QUALIFYING AS SEAMAN TORPEDO MAN.

Likely men are selected to qualify as Seaman Torpedo Men, and are required to undergo a course of instruction in torpedoes and electricity which lasts for 30 working days.

In the British Navy besides the destroyers assigned to the torpedo and gunnery stations for practicing the classes under instruction, three flotillas, each composed of eight torpedo-boat destroyers are kept constantly in commission; these flotillas were organized primarily for the instruction of the engineer's force which is changed each month; the first week of instruction is spent in headquarter waters, where these crews are drilled into knowledge of their duties. Then each flotilla makes an independent sea cruise of three weeks. The purpose of this

month's work is to give the men of engine room ratings instruction in their duties at firing, tending water, oiling, and in the various engineering duties incident to the work of destroyers. It should be remembered that these men are already picked because of their ability as firemen, oilers, etc.

The officer in command of the flotilla exercises his commanding officers in handling the boats under varied conditions, and in tactical drill.

COMMENT ON TORPEDO INSTRUCTION IN THE BRITISH NAVY.

In considering these different courses of torpedo instruction, one must believe that they were brought about and developed as a direct result of the extensive work with torpedo-boats during the yearly manœuvres and at other times. The use of torpedo craft has constantly emphasized their liability to accident from being operated by crews inexperienced in such vessels. In the British service likely men are selected to qualify as Seaman Torpedo Men, and the best of these are later given extensive instruction to enable them to qualify as Leading Torpedo Men. Those of the latter who show particular aptitude are specially selected to qualify as Torpedo Coxswains. It thus results that every man performing important duty aboard these torpedo-boats has received most careful instruction in those duties. The custom of the survival of the fittest holds place. The Leading Torpedo Man is the best of a hundred Seaman Torpedo Men. The Torpedo Coxswain is the best of a hundred Leading Torpedo Men. The commissioning of great numbers of torpedo craft each year, supplements to these various torpedo courses the necessary practical work with these boats, of tactical manœuvres, and the actual war use of the torpedo. The officers on this duty have all been specially trained.

The grand result is that Great Britain's torpedo-boat flotilla is efficient. But this is not all. There exists throughout the British Navy, in both enlisted and commissioned personnel, a comprehensive knowledge of torpedoes and torpedo-boats; when not in commission the boats are kept in efficient condition; when called into active duty valuable time is not lost either in making needed repairs, or in whipping the officers and crews of the boats into knowledge of their duties.

TORPEDO INSTRUCTION IN EUROPEAN CONTINENTAL NAVIES.

In all European continental navies the details of torpedo instruction are kept as secret as possible; nothing official concerning such information is published; but in different ways facts have come out which tell something about it. It may be said that the torpedo officers of these navies are given much instruction with torpedoes and electricity, and that this is followed by much practice in the handling of torpedo-boats underway, and in torpedo marksmanship at moving targets.

The following is taken from different foreign service publications; if there are any complete descriptions of the continental system of torpedo instruction, the writer with much search has been unable to find them.

TORPEDO INSTRUCTION IN THE FRENCH NAVY.

Officers desiring to have instruction in torpedoes are first required to qualify in electricity; after which for six months they are attached to the torpedo school at Toulon, where every morning they first listen to lectures and then do practical work with the torpedo mechanism, and with the electrical instruments used with torpedoes, and every afternoon is spent in running torpedo-boats with torpedo target practice at moving targets; the purpose of this six months' course is to familiarize each student officer with every adjustment required to the varied mechanism of the torpedo, and with the best methods of handling the weapon. After this course at Toulon some of these student officers take part in the constantly recurring torpedo-boat attacks, and thus receive much training in handling the boats. In the yearly manœuvres scores of torpedo-boats take part and torpedo-boat attacks always form a prominent feature of the manœuvres. It is the well-known preparation of the French for an offensive torpedo-boat warfare that has compelled Great Britain to an equal amount of work with the weapon.

Torpedo-boat men of the French Navy are specially selected for their duties. The most intelligent are picked out for special instruction in torpedoes and electricity, and in this way, as in the British service, superior classes of men are developed for this particular work.

A certain proportion of all the boats are kept in continual

commission; each boat in commission is always accompanied by a number of other boats kept in reserve with skeleton crews. The boats in commission are constantly exercised, the regulations directing that they shall make two night sorties every month, and that at least once a quarter they shall undertake systematic manœuvres against a skeleton enemy; each boat in commission is required to fire a torpedo at least three times a month, the boat being underway, and at least twice a month the boat must be travelling at a high rate of speed and the target must be moving. The boats in reserve are at all times kept in efficient condition; at least three or four times a year every boat in reserve is put in full commission and is required to perform a stated amount of regular torpedo-boat duty. When one considers the fact that France possesses several hundred torpedo-boats and destroyers, and that each of these is systematically exercised, one appreciates the great amount of practical experience in handling them that the officers and men of the French navy receive.

TORPEDO INSTRUCTION IN THE GERMAN NAVY.

A Rear-Admiral is designated as "Inspector of Torpedoes." He has charge of all matters technical or otherwise, connected with torpedoes; he is directly in charge of all torpedo-boats and their personnel, organizes and directs their exercises, and is responsible for their efficiency.

There are at all times in existence six "Torpedo-boat Divisions of the Reserve," three of which have headquarters at Wilhelmshaven and three at Kiel. Each division consists of one "Torpedo Division Boat" which is permanently commissioned as a depot-ship, and eight torpedo-boats. There are also at each of these stations two instructional torpedo-boats which are permanently commissioned; these are used to train the personnel.

In the Autumn of each year a division of boats is commissioned at Kiel and another division at Wilhelmshaven; these are kept in constant torpedo practice until late in the year; early in the following April these divisions continue their practice and later are assigned for work in the autumn manœuvres; besides these, other torpedo-boats are commissioned for the autumn manœuvres, and are given three months' training beforehand; by much instruction and continual change of officers and men the

German navy may be said to be efficient at torpedo warfare; indeed the tactics of torpedo-boat attack at present practiced by most navies were originated and developed by the Germans.

TORPEDO INSTRUCTION IN THE RUSSIAN NAVY.

The Russian Naval Torpedo School is situated at Kronstadt; the number of student officers here undergoing instruction is limited to twenty-four, who are chosen from a number of officers that have undergone extensive study and practice for the purpose of entering this school; the course of study is limited to one year, which time is devoted to torpedoes and electricity. In conjunction with this Kronstadt school there is an instructional torpedo-boat flotilla in the Baltic Sea, and an evolutionary torpedo-boat squadron in the Black Sea. The instructional torpedo-boat flotilla of the Baltic Sea is commissioned every year for three months; the time is spent in exercising the officers and men in various duties pertaining to torpedo warfare; the evolutionary squadron for training is commissioned every year in the Black Sea. It consists generally of twenty torpedo-boats, and for several months is exercised for the purpose of training officers and men.

PART IV.

THE TORPEDO-BOAT TRAINING NEEDED BY OUR NAVY.

All great naval powers possess torpedo-craft and all are prepared to use them. We have seen that in European countries much instruction is given in torpedoes and torpedo-boats to those who are to handle them. In our navy such instruction has been limited to but a few, and even to these few the time for such instruction has been much restricted. If all of our torpedo-craft were now to be commissioned for war service we would have to hope that the general excellence and zeal of our personnel would make up for the special instruction that we lack and which other services have had. But how much more formidable our torpedo-boat flotilla would be if its entire personnel were composed of officers and men all trained and experienced in their duties, and possessed of a confidence that comes from skill!

An intelligent appreciation of this weapon and of its possi-

bilities, combined with a knowledge of when and how and where to use it, is necessary if it is to have effect in bringing war to a successful close. This requires on the part of the operators knowledge of the torpedo's mechanism, skill in making adjustments and in making repairs, and in the use of all instruments used with torpedoes and with torpedo-boats; the torpedo-boat officer should possess much experience in handling small frail craft of great vulnerability and of tremendous engine power; he should be a practical engineer, and he should have a knowledge of the best methods of torpedo-boat attack under various circumstances. The enlisted men should be picked men who have received special instruction for their particular duties.

It is not probable that our entire torpedo-boat flotilla will ever be commissioned, but in order that it might be mobilized for immediate effective service it is essential that special torpedo instruction should be possessed not only by a few, but by many throughout the service, so that to commission many boats would not be an embarrassing matter to the Navy Department.

Besides the ability to make destructive torpedo-boat attacks, our navy must be prepared to repel such attacks when made against us. Sincere as is our friendship with foreign powers it is still an armed friendship, and we are preparing to defend ourselves against any attack made by the navy of any foreign power; most European navies possess hundreds of torpedo-boats, and we must contemplate attack not from battleships alone, but also from these torpedo craft; officers who have had practical experience with torpedo-boats and who understand them in all respects, in their possibilities and in their limitations, are surely best qualified to repel attack from such boats.

It is apparent that our government has embarked upon a policy of yearly naval manœuvres on a scale commensurate with our necessities; torpedo-boat attack must always form a prominent part of the manœuvres; the education and training received both by the officers and crews making such attacks, and by those repelling them will be most valuable if our torpedo-boats are handled by experts.

It seems that every possible consideration of our naval needs imperatively demands that torpedo instruction become important in our navy; it must be agreed that at present such instruction is open to but very few, and to these few it is limited in

extent. With all of its capabilities for instruction, the Newport torpedo school had but three officers receiving instruction last summer, and each of these three officers was detached and ordered to other duty before much instruction was received; this of course is caused by the scarcity of officers; but it is certain that the personnel will soon be largely increased, and if our naval officers will consider the importance of torpedo instruction a policy instituting such instruction will surely be adopted and carried out.

At the present time our navy is not entirely without torpedo instruction; a small part of it is receiving training of the highest character in torpedoes and torpedo-boats; the trouble is that this part is so very small; the instruction should be so very general, that, should it be necessary to mobilize a flotilla of torpedo-boats, it ought not to be difficult to commission them with officers and crews already experienced in torpedo-boat work. This torpedo instruction at present existing in our navy may be divided into three parts, each of which has grown up independent of the other two. The first part is the instruction given at the Naval Torpedo Station at Newport; the second part is the instruction received by the officers and men in charge of the torpedo-boats in reserve; and the third part is the instruction received by the officers and men attached to boats in regular service commission.

The first of these, at Newport, provides instruction for officers and men.

The regular course of instruction for officers is limited to 29 working days; this time is devoted to lectures and to practical work; the subjects considered are electricity, torpedoes, and torpedo-boats, and instruments and implements used with them, to explosives and to mines; this course includes the torpedo adjustments, the handling of torpedo craft, and torpedo target practice at moving targets from boats underway; this instruction has not been regular because no policy of ordering officers to undergo it has ever been adopted and then carried out; this year it has not been given because no officers have been ordered to take it. Last summer some of the officers attached to the North Atlantic Squadron received torpedo instruction at this station; this special course lasted for six weeks; the time was devoted to lectures and to practical work; the subjects under

consideration were the assembling and disassembling, the installation and the adjustments of the various parts of the torpedo mechanism; to torpedo target practice from boats underway, to air compressors, electric attachments, mines, and explosives.

At the Torpedo Station there are classes of enlisted men receiving instruction; this is shown in the following which is an extract from the Annual Report of the Naval Torpedo Station for 1902:

SEAMEN GUNNERS' CLASS.

"There are accommodations for a class of about fifty seamen gunners and nearly double this number could be graduated each year were it practicable to have that many sent here. The facilities and work required for a large class are but little greater than for a small one, particularly if a number of men or even a whole class could be sent at the same time. The total number under instruction during the last year has been 33, of which number 20 have received certificates of graduation, one failed to qualify, nineteen have taken the course in diving, and ten are at present in the class. The full course embraces the following subjects, covering six months' time:

Electrical work (instruction)	2 weeks.
Electrical work (practical)	2 weeks.
Dynamo room	4 weeks.
Explosives and torpedo material	4 weeks.
Torpedoes	4 weeks.
Torpedo-boat work	1 week.
High speed engines, steam	3 weeks.
Diving (optional)	3 weeks.
Review	1 week.

Owing to the great demand in the service for graduates of this course of instruction the Department has had to resort to the expediency of shortening the course to three months, and the time has been allotted in accordance therewith as follows:

Electrical instruction and practical work	1 week.
Explosives, torpedo material and mines	3 weeks.
Torpedoes	4 weeks.
Running air compressors	2 weeks.
Diving	2 weeks.

It will be seen that the full course gives 11 weeks to electricity, dynamos and high speed engines. The new rate of electrician, with the electrical school at New York, no longer renders this extended instruction necessary for seamen gunners, and it has been limited to practical work with batteries, electric firing circuits, wiring, splicing, and testing circuits in connection with firing devices, mining, etc.

Engineers' Class.

This class was established January 1, 1902, for the purpose of training machinists and firemen to perform the duties of their ratings on board torpedo-boats, and the course was limited to three months. The requirements of the service, however, have shown an even more urgent demand for water tenders and oilers for these boats. It is found practicable to train a second class machinist to be an oiler in three months, but only in rare cases can a new recruit be made a water tender in the same time. It is to be remembered that on a torpedo-boat even more than on a large ship, the water tender is the back-bone of the fire-room force. Not only must he be a man with a thorough knowledge of the boilers, piping and pumps, but he must have besides this the faculty of the control of men, the quality of coolness in emergency, and a keen sense of responsibility. Things happen quickly in the fire-room of a torpedo-boat and a moment's hesitation may mean a new boiler. The men to discharge the duties of this rate cannot be developed in three months, but should be carefully selected from the best firemen in the service and then given at least six months' instruction in the particular duties of their rating.

The boats used in training this class are the Morris, McKee, Dahlgren, Craven, Winslow, Stiletto, and 3rd class boats Nos. 1 and 2. The variety of types is advantageous in that the men become acquainted with the different boilers and engines used in the Navy.

The course of instruction is given under eleven subjects for machinists and eight subjects for firemen and coal passers, as shown by the following schedule:

ENGINE ROOM.

(1) Main engines; arrangements and sizes of cylinders; valves; shafting; propellers; etc.

(2) Condensers, construction and purpose; how tubes are packed, plugged or withdrawn and replaced; how to test a condenser. Air and circulating pumps and all attachments.

(3) Auxiliaries; dynamo engine; steering engine; blower engine and compressor.

(4) Piping, leads of and purposes; situation, construction, and manipulation of all valves and their purposes. Situation of water tanks, connections and capacities.

(5) The particular duty of each part of the main engine. How pistons and valves are made steam tight.

(6) The purpose and general construction of the throttle valves, reversing gear, valve shaft, pass overs, drains, relief valves and traps.

(7) How to grind in and reseat valves; packing of glands and joints; different kinds of packing.

(8) Oil and water service. Difference in character of various oils.

(9) Bearings; construction, adjustments, cooling.

(10) Indicators and counters, and indicator cards.

(11) Keeping the log; overhauling engines; adjustments.

BOILER ROOM.

(1) Construction and distinguishing features of the Thornycroft, Mosher, and Normand boilers.
(2) Boiler fittings.
(3) Feed pumps and their operation, derangements and remedies.
(4) Tending water.
(5) Tending fires under varying conditions of the forced draft.
(6) Care and preservation of water-tube boilers; cleaning boilers.
(7) Repairs to boilers; fitting man-hole gaskets; plugging and replacing tubes; repairing brick-work.
(8) Drainage and syphon systems.

For practical work the McKee, Stiletto, and torpedo-boats Nos. 1 and 2 go out twice a day, forenoon and afternoon, for two-hour runs and manœuvring, in charge of gunners and gunners' mates. The Winslow and Morris or Dahlgren and Craven go once a day or as often as officers can be spared to go in charge.

The machinists, upon arrival, are first assigned to the fire room of one of the small boats for a week, and then are transferred to the fire rooms of the larger boats for a week and later to the engine rooms. In a similar manner, the firemen, after three weeks in the fire room of each class of boat are given one week in the engine room."

The contrast between the torpedo instruction given in our navy and that in the British navy is striking; the reason that our navy has received so little is not because it is believed that this little is sufficient, but partly because until the present our torpedo flotilla has been feeble in numbers, and also because it has been impossible to spare officers and men for extended instruction.

The second part of what may be called our torpedo-boat system consists of the boats commissioned in reserve at Norfolk and at Mare Island. At Norfolk there are ten or more boats commissioned in reserve, to which are attached three commissioned and one warrant officer, and a few enlisted men; the duties are to keep these boats in efficient condition, ready for service; to exercise the different boats occasionally at high speeds; to have torpedo target practice from boats underway; and to train the enlisted men in their duties. In connection with these duties there is much repairing and overhauling of machinery which would afford excellent instruction in engineering to young officers; though the extent of space devoted to machinery in a ship might within limits determine the number of the engineering personnel, yet it is the horse power that must meas-

ure the talent required; this is recognized in the British service, where we find that the engineer officers attached to destroyers are generally Chief Engineers in rank. The engine power of our new destroyers averages nearly 2000 horse power more than that of most of the British destroyers; it approximates to the engine power of the Newark and Philadelphia, of about 4500 tons displacement; surely engines of 8000 horse power should be in the charge of an experienced engineer rather than in the charge of a novice; if we are to have a torpedo flotilla it is absolutely essential that young officers should be prepared for such engineering duties; the duty of the torpedo-boat is to bring the torpedo within striking distance, and this demands that the boilers and engines of the boat be in most efficient condition. The constant running of the torpedo-boats commissioned in reserve at Norfolk, with the consequent overhaul and repair of machinery, offers excellent opportunity for training intelligent young officers in the practical care and repair of machinery.

The third part of our torpedo-boat system is that of the cruising section; this must always remain the capping stone of all torpedo-boat instruction; the section at present in commission consists of one destroyer and six boats; these are in constant activity in all ways that would tend to make these craft efficient for what might be expected of them in war service; the boats are exercised separately and in section; the exercises that are followed are designed to give the personnel of the section practice in handling the boats under various conditions, and also in handling the torpedoes. It will be agreed that torpedo-boat attack upon modern warships will not be successful unless the boats making it have had much drill in torpedo-boat tactics; as a result of such drill it is confidently believed that an attack by Lieutenant Chandler's section upon any warship would doom that warship to destruction. This section uses the German tactics; the section approaches at full speed, the boats grouped to form a wedge; when at a desired distance from the point of attack the boats disperse, fire their torpedoes, and endeavor to get away; to show how well the personnel has been trained in handling the boats it may be stated that when making these attacks the boats while travelling at full speed are held so closely together, the bow of one boat touching the quarter of the one just ahead, that a person can easily walk from the leading to the rear boats; when the signal for dispersion is made there is

no collision, no confusion; and nine of every ten torpedoes discharged would destroy their targets.

From what has been done by this section it is believed that our navy has great torpedo-boat possibilities; the great disideratum is that the entire flotilla might be mobilized, if desired, by an efficient, trained personnel; that this might be systematic, instead of desultory and uncertain, instruction should be inaugurated in our navy, of a nature that would insure that throughout the service there would be many officers and men trained and experienced in torpedo-boat duties. It is probable that the personnel of the navy will soon be increased, and that time for such instruction will be possible, it is suggested that something of the following nature would produce the desired results:

(1) Three months instruction for many officers and men at Newport in torpedoes and electricity.

Following this for some specially selected for torpedo-boat work:

(2) Six months duty and instruction in connection with the boats commissioned in reserve at Newport and Mare Island, where the instruction would principally be in engineering; the duty of keeping the machinery and boilers of these boats in efficient condition would of itself be instruction of the highest and most useful type, and, as all line officers must be practical engineers, such instruction could be made most valuable to the general service.

For some of the officers and men who have had this Newport and engineering instruction:

(3) Duty for six months or longer aboard destroyers and torpedo-boats in commission, with drills and exercises modeled from those used at present by the torpedo-boat section commanded by Lieutenant Chandler.

In 1898 Lieutenant Commander Kimball said:

"If we are ever to have use for a navy of fighting ships we must have an efficient torpedo-boat service to supplement the fixed coast defenses, or our fighting ships will surely be deflected from their legitimate off-shore work to the in-shore defense of our posts and coasts."

"From the extent and condition of our attackable coast, and from the fact that torpedo-boats are the only craft (bar armorclads) that can check raiding armorclads, we should lead the world instead of lagging behind it, in the development of torpedo-boat efficiency."

"We question the utility of torpedo-boats because we don't know how to utilize them."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SIZE OF BATTLESHIPS FOR U. S. NAVY.

By LIEUTENANT HOMER C. POUNDSTONE, U. S. Navy.

I. GENERAL CONSIDERATIONS.

Next to the necessity for a continuous and continued yearly increase to the number of armored vessels for the fighting line of our navy, it is of *prime* importance to decide upon the general *type of battleship* best suited to meet *all* the requirements of our service, and then to consistently build after that type and thus secure homogeneity in the units of the fighting fleet "A consummation devoutly to be wished," and certainly one not impossible nor impracticable of fulfillment.

The writer is aware that a considerable number of officers in the service rather deprecate the decision to build vessels as large as our newest type of battleship, the Louisiana class; believing—as they evidently do—that our interests will be best served by a smaller class of vessel, something, for example, like the Indiana, or perhaps a little larger! To this the writer's reply would be, "Why build *anything* less formidable and effective than the best?"; when, with the material interests, reputation and honor of our country always at stake, we not only *can* but *should* build the best that genius can design and money provide. Money considerations, too, are all very well in their proper time and place; but, for instance, if we should build and maintain a fleet of even as many as 50 Connecticuts, the expenditure involved would not constitute an extravagant insurance on the material wealth and for the continued peace of our big country.

It is the writer's firm belief and honest opinion that this is one of the cases where "The biggest is the best"; and this is considered especially true of a battleship in which all-around

strength (power) is *only* to be had by making the displacement sufficiently large to accommodate the highest possible values for each of the elements which must be considered and embodied in the design of a vessel intended not only to take and be able to give hard knocks, but which must stand up to such work in a fight to the finish. Again, the writer believes that this is *preeminently* a case where "The best is the cheapest"; and it is susceptible of convincing proof that *this* is correct, to the utmost limit, in battleship design and construction.

With these two rather strong assertions kept always in sight, and with the further statement of fact that our possible enemies are continually increasing the displacements of their fighting units to secure greater power, the writer submits his opinions, on this important subject of the size of battleships, to the service solely with an idea to induce that criticism and discussion which is absolutely necessary to an intelligent determination of a question requiring for its solution the highest talent and greatest ability of which our service is possessed; that question *is*, briefly, "What type of battleships should we build?"

II. How Size of Battleships should be Determined.

In the absence of a carefully thought-out, well-defined and accurately-adjusted building programme, the above is a matter which should be replete with interest and of deep concern to the entire naval service. It is not a determination which may be left to the individual opinion of even such distinguished and capable officers as may happen to be called before the naval committees of Congress, much less to the chance decision of our national legislature, the members of which may not only *not* be expected to understand what is needed in this regard, but who are, from their positions, entitled to have and *should* have furnished to them, by the Department of the Navy, all the considerations, technical, tactical and strategic, which logically govern and finally determine the character of the types of new construction demanded; and these data should be so "boiled down," *ready for use*, that the framing of the acts for an increase of naval materiel may be readily and intelligently undertaken; and said acts *must*, in all reason, be formulated in strict accordance with the recommendations so made by the

Department of the Navy. The question of the numbers of each type to be appropriated for at any one time must of course rest with Congress, but *only* after the Department has plainly indicated the *necessities* in each particular regard.

No one denies, or *can* deny, in the light of the newly added and enormous responsibilities of our country, that what the navy needs, and *must* have, is a regular yearly addition to the navy list in the way of armored construction; the writer would say powerful battleships and big, fast armored cruisers. It is, however, incumbent upon the service (and it *must* not shirk the responsibility) to determine the best types and the numbers of each type necessary to carry out the schemes of offense and defense for which *it*, its officers, men and administrative organization are maintained by the country. The civilian head of the Navy Department, whatever his attainments, ability and force of character, must largely depend upon the service for intelligent conviction as to the needs of the naval establishments; and to throw upon Congress the burden of determining what *can* be known only to those whose profession and business it is *to* know seems to indicate an uncertainty of policy which the best naval opinion does not justify. The national legislature neither has nor seeks for the technically accurate knowledge to enable it to make such determinations, and it is neither fair nor just to the members of its naval committees, but an absolute imposition on their time, patience and good nature, to expect or require them to do work which can only be done practically and rationally by experts.

Perhaps the time will soon come, it *may* even be at hand, when the creation of a General Staff will, *by law*, bring to the solution of such problems as this the best genius, highest attainment and most acknowledged ability of the service; and give to the Navy Department a technical advisory staff whose chief duty it shall be to outline the naval policy of the government, advise the Secretary of the Navy on all questions relating to service efficiency, and determine, for the best interests of the navy, all matters demanding purely technical decisions. It is certain that the navy needs, for its proper and most effective administration, the services of such a body of its brightest officers whose *sole* duty, aim, study, and effort shall be devoted to the broader questions of naval policy and efficiency. From

such a staff, we might well expect a convincing definition of the needs of the service both as to materiel and personnel; and we should have confidence that the whole gamut of subjects, relating to the preparedness of the navy for war, was receiving that profound consideration and deliberate, studied attention which its importance demands.

III. Battleships to be Really Powerful must have Large Displacement.

The modern battleship or fighting unit requires, indeed imperatively demands, large displacement to assure her of being able to carry an effective battery and its protection as that term is now understood; that is, protection not only to hull buoyancy, engines, boilers, and magazines (which same is more extended than ever before), but proper, efficient protection to the battery itself, to its ammunition supply, to the personnel of battery and to interior communication.

To be able to meet, and fight on fair terms, a powerful enemy, our battleship must have equal or, if possible, better speed and good coal endurance, and she must be reasonably handy in order not to lose even a single point in the game. The necessities of modern strategy require that our battleship shall be able to keep the sea in any and all weathers, and be capable of maintaining a selected station for long intervals, and she should house her officers and crew easily and comfortably; in other words, she must be not only *sea-going* but *sea-keeping,* and she must be habitable to preserve the health, vigor and efficiency of her personnel.

It goes without necessity for proof, other than most casual observation and examination, that a battleship of small displacement, in which it has been attempted to get a high coefficient of compromise for the various elements of power, may, when everything else has been attended to, find her crew space cut down to very short commons, and, in fact, quite insufficient for even a peace complement and certain to be overcrowded when she is on a war footing. This circumstance, and the attendant necessity to neglect the comfort and health of the personnel, is a distinctly bad feature almost inevitably inherent in such designs, and can but tend to be more or less crippling to efficiency.

Keeping these evident facts constantly in mind, it will appear

that the highest type *possible* will result where each of the main elements of design—viz.: offensive power, protection, speed, coal endurance, handiness, sea-keeping ability and habitability—has its greatest practicable value, or where a compromise amongst these several elements gives the highest final total efficiency; and, if we take our latest class—Louisiana and Connecticut—as a fair exemplar, that is embodying in a high degree all of the above mentioned elements, it will be easy to conclude that powerful battleships—such as our newly laid-down ones *certainly* are—*must* have large displacements, such as we have been forced to adopt for this latest class; and it is the writer's belief that *the* battleship of the future will displace *not less* than 18,000 tons on full load.

If, then, it be conceded that large displacements are *absolutely* necessary to give a big fighting efficiency factor, the *converse* must be true; namely, that the small type of battleship implies and involves serious sacrifices in some one or more, or *all*, of the elements which go to make up what is known as *power*—be it offensive, defensive, motive, coal endurance or sea-keeping ability.

Of the fact that great power in battleships must be provided for by large displacements we have a singularly convincing illustration in our own navy. An examination of the plans and specifications of the various types intervening between our Indiana class and the Louisiana class, and *including* those two classes, as they are farthest apart as to time of laying down, will show, in the most forceful manner possible, how the displacement has *had* to be increased for each and every increment to the power elements, of the *particular* design, in excess of those of the *preceding* less powerful type; or, in a broad sense, every iota of power added has inevitably carried with it an augmentation of the displacement; the principle involved may then be summarized into the indisputable conclusion that great power in battleships *demands* large displacements; that is, we *must* pay in weight for each and every gain in power.

IV. General Comparison of Indiana and Louisiana Types.

For the purpose of illustrating what the writer believes to be the unwisdom of a possible reversion to a small type of battleship, it is proposed to contrast, in a general way, the Indiana

of 10,300 tons and the Louisiana of 16,000 tons normal displacement *as type ships*, at opposite ends of the scale as to displacement, time of laying down, and, no one will deny, as to power.

Before proceeding, it is a fact worthy of particular mention that the Louisiana and Connecticut constitute the first and only class of battleships, yet designed for *our* service, that is denominated, or *really* entitled to the denomination, *seagoing;* all others, to date, being very properly called *coast-line* battleships, which vessels, though entirely capable of going to sea, are not adapted to nor intended for long-continued operations at a distance from our own coasts. They *are* used for distant cruising, and no one will attempt to decry the wonderful cruising record of the Oregon, nor to derogate from the good performances, in this regard, of the Iowa, Kentucky, Wisconsin, and Illinois; still this is *not* their proper sphere of action and the reasons for such use of them have been compulsory, much after the manner in which it was found necessary to make use of the torpedo boats during the war with Spain. The fact remains that the low freeboard, entire or partial, of the coast-line battleships detracts from their sea-keeping qualities, and, in heavy weather, is believed to constitute a menace of no small proportions to their sea-going integrity; which belief the writer has heard emphasized in no mild terms by officers who have cruised in the low freeboard types, particularly the Indiana class.

To proceed with the comparison, it is acknowledged that the offensive power of the Indiana class is wonderful for a vessel of that size; but it is a far cry from the almost insignificant auxiliary battery of four 6-inch guns on the Indiana to the twelve 7-inch of the Louisiana, neglecting the 8-inch and heavier calibre guns as *practically* common to both; and, when it is also remembered that the Louisiana is, in addition, to carry twenty 3-inch R. F. guns with fair protection for nearly all of them, and that *all* of the 7-inch guns are to be in separate casemates armored *all over*, the jump-up in displacement of the Louisiana type is readily understandable; and, too, the arrangements for supply of ammunition, where each isolated gun has its own hoist, costs a considerable total in weight, as do numerous equally valuable incidental features of the design for these fine new battleships. Nor must we lose sight of the hull and battery protection of the new vessels, which are not only *very* much more

extended but vastly more *efficient* than the same factors in the Indiana type.

The small displacement of the Indiana class was secured by a notable sacrifice in the speed element and a *vital* sacrifice in the matter of hull and battery protection, which latter would not, for one minute, be considered efficient if this class of vessels had to be taken under advisement as a type to be laid down to-day.

It is neither necessary nor desirable to go into detailed particulars in this comparison, the general characteristics of these vessels are well known or may be readily ascertained, but an examination of the plans and specifications of the Indiana class will fully reveal their defective protection to hull, ammunition supply and the auxiliary battery and its personnel.

It may be urged that if an Indiana were to be laid down to-day, on the same displacement, a better compromise could be secured amongst the several elements, entering battleship design, than was considered possible at the date she was originally put on the building blocks. This is only barely probable and necessary in a very limited degree, for it still takes weight to get each required element, and even with the tremendous strides that have been made towards securing more resisting armor for less thickness, and the decrease in weights of engines and boilers for same power, it would, without any shadow of doubt, be found, that the *new* Indiana's final combination of power elements would not be far different from what it is now, assuming that the present powerful battery was retained and given all permissible protection.

If this class (Indiana, Massachusetts and Oregon) is ever rebuilt, and it is to be hoped that it *will* be, in so far as balancing turrets and isolating and protecting casemate guns are concerned, the small displacement is an effective bar to making requisite protection of hull, battery and ammunition supply *entirely* efficient.

The comparison, along the same lines, may be extended to include all the classes later than the Indiana; the Iowa of 11,300 tons, sole representative of her class; the Kearsarge class of 11,500 tons; the Alabama class of 11,600 tons; the Maine class of 12,300 tons and the Virginia class of practically 15,000 tons normal displacement, though the Chief Constructor of the Navy

reports that the delay in construction work on the Virginia class has afforded an opportunity to considerably increase the military value of the units of same by carefully revising their general plans and bringing them as nearly up to date as, evidently, the displacement will permit.

In these classes, later than the Indiana, the speed element has been materially augmented and we readily note what it has cost in weight. For the Iowa, it took 1000 tons of displacement to get her increased freeboard forward and an excess of two knots in speed over the Indiana; and, in the later ships where the speed factor has been kept high (16-19 knots) and more given also to protection, the displacements show a *constant rise* roughly proportional to the increase in the various factors of total power; until, in the latest type, the Louisiana class—which, with the high speed of 18 knots, combines in the greatest practicable degree offensive power and protection—we have reached a trial displacement of 16,000 tons that will doubtless eventuate in a deep load displacement amounting to very nearly 18,000 tons.

We have, then, by increasing our full load displacement to approximately 18,000 tons, as in the Louisiana class, gained tremendously in offensive power (compare batteries of the various types from the Indiana to the Virginia with battery of the Louisiana), and we are able to carry a practically efficient protection to hull, battery, ammunition supply and to personnel (which desideratum is *impossible* on a displacement as small as that of the Indiana), and we have increased the speed *three* knots over that of the Indiana class, and *all* with no loss in coal carrying capacity nor, it is believed, in turning and manoeuvering ability; and we also have a type that is habitable and comfortable for its personnel under any conditions of wind, weather and sea, and whose sea-going and sea-keeping ability is an indubitable maximum.

Nor must it be lost sight of that the gain in protection is *real* protection, and especially is this true of the casemates which are entirely armored isolated compartments where the gun ports are *actually* closed, by the cylindrical gun shields, in all positions of the gun. In the majority of our former battleships, a great deal of *so-called* protection is carried simply as dead weight; gaping ports, armored only around their edges, stand

invitingly open to the hail of an enemy's projectiles, and the partial splinter bulkheads (affording no segregation to effects of bursting shell) are only a further insurance that no personnel *could* live at the casemate guns for longer than the first few minutes of an action.

V. Conclusions as to Displacement.

In conclusion of the writer's views as to the absolutely unqualified necessity for battleships of large displacement, the question naturally suggests itself, " Have we exceeded reasonable and practicable limits in demanding such a displacement as that of the Louisiana, *if* we take into consideration that we have developed a type of ship that combines reasonably high speed with offensive and defensive power of the *very* highest order and does *not* sacrifice any of the remaining important elements of design, viz.: coal endurance, handiness, sea-keeping ability and habitability?"

It seems to the writer that there *can* be but one answer to this question. We have seen that *each* attempt to improve on the design of our various types, from the Indiana to the Virginia, has resulted in an increase of displacement, and inevitably so to carry the increasingly powerful batteries and to properly and efficiently (as it was understood at the time) protect the hull, armament, ammunition supply, interior communication and the personnel. We have finally evolved a *very* powerful type of ship in the Louisiana class, and such ships we *must* have, and in considerable numbers, if we mean to be even fairly prepared to match our ships-of-the-line against those of a strong antagonist. We should, therefore, not neglect to watch what our possible or probable enemies are doing in this regard, and we must be able to meet *any* enemy if we propose, *which we do*, to defend our national honor, uphold our national policies, and maintain our national existence unimpaired.

Every first-class naval power (with the sole exception of Italy, and she is making what the writer believes to be an expensive experiment) has *already*—or is being rapidly forced to do so by the logic of the situation—adopted, as a battle unit, vessels of nearly or quite the displacement of *our* latest type; and we are in a position where we cannot afford to be only *good* in this particular, we must be *very good*; and it would be wise and pru-

dent to stand always just a little better than the "other fellow;" and by him I mean the possible, even probable, next antagonist.

Taking it all in all, then, the design of our latest battleships would seem to fully and abundantly justify its existence, and it challenges comparison with the best that is being done, in the same line, abroad. Certainly there is *no* doubt in the writer's mind that our *type* battleship should be *both* large and strong.

VI. Objections made by Opponents of Big Battleships.

The main objections, which the writer has heard brought forward as arguments by the opponents of the policy of building large battleships, are as to their alleged lack of handiness; their deep draft and great beam which are said to render it difficult and dangerous to bring them into even our principal harbors and will preclude their using many of our good harbors; and, on account of their draft and beam (principally the latter), that it is a serious question to find docking facilities for them; finally, their great first cost has been particularly insisted upon as a factor in opposition, the contention being that we may have *many* more of the small battleships for a given number of the powerful large ones. Let us examine these objections and meet them as far as may be.

Handiness.—As to the alleged unhandiness, in manoeuvering of war vessels as large as the Louisiana, it is not believed to exist in anything like the degree that is claimed. Arguments, pro and con, as to the turning qualities of these new vessels, and their general handiness, must as yet be based only and entirely upon conjecture. Certain it is that everything that *could* be done by their designers has been done to insure their having the proper form and balance so necessary to facility and certainty in handling. Bad steering and turning qualities are not imperatively inherent with vessels of the size of the Louisiana class, and the model tank experiments prove that an unusually excellent form of hull has been obtained; we may therefore expect these large vessels to prove all that could reasonably be desired in this important particular. However, nothing is *certain*, in this regard, until these vessels have been actually tried. Experience abroad has shown that numbers of vessels of sup-

posedly good design as to handiness have turned out to be brutes under the helm; while others, that were not expected to have good turning qualities, have shown surprisingly small tactical diameters and proven more than fairly easy to steer. The actual difference between the qualities of handiness in two such vessels, for instance as the Indiana and the Louisiana, *cannot* be very considerable, when, as ships go, both may be classed amongst craft known as " large " and " unhandy."

With all faith in the designers and the design, we can only wait until it is *demonstrated* that these new vessels are the unwieldy, unmanageable monsters that their opponents assert them as likely to be. The writer, for one, is not inclined to doubt that they will prove as easily handled and quite as easily steered as the Indiana class, the units of which have given many a helmsman, deck officer and captain *the* scare of his life by " taking the bit in her teeth " at a critical moment.

Draft.—Attention is particularly invited to the mean draft of the various classes of battleships already completed, and especially to the draft of the Indiana class, the pioneer type of our battleship fleet. Reference to the actual data on this subject will conclusively demonstrate that the objections to large displacement on the score of draft are not tenable; as it transpires that the mean draft of the Indiana class of 10,300 tons displacement is only *six* inches less than that of the Louisiana of 16,000 tons displacement; and, what is more and *worse*, that the mean draft of the Indiana class is greater than that of *any* of the later battleships—until we come to the Louisiana—with the sole exception of the Iowa, which vessel, by the way, is only an improved Indiana. The argument, then, that abnormal deep draft must necessarily result where we have large displacement is found to be singularly in error; as we discover the two smallest types of battleships in our Navy actually drawing more water than any of their successors until we come to the Louisiana, whose displacement is nearly or quite *half again* as much as that of either of the two types just referred to. Moreover, it is believed that the Indiana's maximum draft of 27 feet will prove to be in excess of the full load draft of the newest battleships, which are designed for a gross draft of 26¾ feet. Therefore, *any* harbor that the Indiana, our *smallest* type, can enter or use is equally available to the Louisiana class. It may be ex-

plained that the constructors have put a lot more of the displacement into beam and length; very well, the *draft* objection disappears just the same.

Docks.—To the contention that docking facilities are difficult to command for vessels of as large dimensions as the Louisiana class, it can be well answered by a statement of the fact that we are building, and hope to soon complete, a *number* of large graving docks capable of accommodating the increased length, beam and draft of these new ships; and these docks, or most of them, will *certainly* be ready for use before the ships *can* be completed. Then, too, the general tendency, the world over, is toward an increase in the size and capacity of both the government and the private docks; so that the objection to the size of the Louisiana class, on account of our alleged inability to dock them whenever necessary, is fast disappearing if not already out of sight. However, to guard against the *possibility* of finding ourselves crippled, as in time of war, from the lack of proper docking facilities *wherever* we are likely to need them, it is more than evident that we must have docks, capable of taking the largest vessel we are ever *likely* to build, at Olongapo, Honolulu, in Porto Rico or vicinity, and *one* on the south coast of Cuba, Guantanamo is an ideal place.

Cost.—Now let us come to the question of first cost, *this* having been made a particular point by the opponents of big battleships and the advocates of and for small ones. The Louisiana is to cost, for hull and machinery, approximately four million dollars; and the units of the Indiana class have each cost a little upwards of three million dollars; so, unless the difference in cost of armor and armament for the two vessels is enormous, it is not unfair to regard the *relative* first costs as four to three. *The* main argument, in favor of smaller battleships, has been that we could have *many* more units for a given sum of money, when, as matter of indisputable fact, we may only have four Indianas, for instance, to three Louisianas; and, to the rational, practical, unprejudiced mind, there can be no possible doubt as to the result of an action between two squadrons, one composed of four Indianas and the other of three Louisianas. It is patent, on the very face of things, that the three big powerful battleships could easily and handsomely destroy

the four small ones, especially as the latter are vulnerably deficient in all-around protection. Let us suppose, further, that the numbers in both instances are doubled, and that one Commander-in-Chief has six Connecticuts and the other eight Oregons; what is likely to be the outcome of an encounter between two such forces? For every reason of which the writer can think or conceive—taking it for granted that the ships are handled and fought with equal skill and ability—he would expect every one of the Connecticuts to survive and *all* of the Oregons to be either sunk or totally disabled. The matter of first cost, then, is *not* so clearly or *evidently* in favor of a smaller type of battleship, and certainly in nothing like the degree often claimed; and, if there be *any* advantage *at all* in this regard, after giving due weight to *all* of the attendant considerations, inherent and collateral, the *writer* is of the opinion that same rests *strongly* with the vessel of powerful type having the great displacement. Certainly if fighting efficiency *alone* is to be considered, the larger vessel is vastly the more economical. In the question of maintenance, too, the ratio of four to three would appear to be still a fairly accurate relative expression of such expense. The Indiana's complement is put down at 32 officers and 470 men. On a war footing she would, undoubtedly, carry as many as 100 more men, or 570. The rated accommodation of the Louisiana class is for 40 officers and 761 men, and we find that 761 is to 570 just about as 4 to 3. The relative cost of coal, stores and miscellaneous supplies necessary to the upkeep of the two vessels will doubtless come to very nearly the same ratio, hence the comparison (as to expense) on a basis of *first cost* may reasonably be carried alono into the life of the ship, even possibly, to docking and repairs, and same *plainly* appears to constitute a *refutation* instead of a *proof* that we may have *many* more of the smaller units for an equal expenditure of money. Nor are the reasons for the existence of a fleet of relatively small and necessarily inferior battleships either logical or at all convincing; and there is no apparent justification, beyond mere assertion, that we should be in more formidable fighting condition if we were even possessed of the (permissibly) greater number of smaller battle units.

NOTE.—It is the writer's intention to follow this paper with another, now in course of preparation, relative to *Proposed Armament for Type*

Battleship of U. S. Navy; and, as the questions of displacement, battery power and protection are so interdependent, the writer begs to request that the two papers may be taken *together* as representing the whole expression of his convictions, view-point and opinion on the important subject of the best *type of battleship* to adopt and build after, in augmenting the number of units for our first line-of-battle, in order that *all* our future battleships may be, as nearly as possible, absolutely homogeneous in character and quite as powerful, in *every* respect, as any similar vessels they may ever be expected to engage.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVIGATOR'S PRISM.

By LIEUT.-COMMANDER JOHN B. BLISH, U. S. Navy.

With the close of the last century there came about a most active period of telegraph cable laying in the Atlantic Ocean under the flags of the four great commercial and maritime countries. In 1898 the French laid the then longest stretch of cable from Brest to Cape Cod; among the British expenses of the Boer War was a cable from the Cape to England, touching foreign soil only at the Cape de Verde Islands; in 1900 the first German trans-Atlantic cable was laid from Emsden to Coney Island via the Azores, and at the same time the Commercial Cable Company of New York put down their connecting cable from Nova Scotia to the Azores.

This last cable, made and laid by Siemens Brothers & Co., of London, was without doubt the most perfect telegraph cable ever manufactured and its laying stands as the most scientific, skillful and successful exhibition of that branch of the seaman's art.

It was the exceeding good fortune of the writer to have been the guest of Mr. William Siemens, the head of the Siemens Company on board their cable-laying steamer Faraday during the laying of the last section of the Commercial Company's Canso-Fayal cable, in the summer of 1900, his invitation having been extended through and most generously approved by Clarence W. Mackay, now president, and by Mr. George G. Ward, manager of the Commercial Cable Company.

Of an equally high order with the making and laying of this cable was the navigation of the Faraday while paying it out, and this too will stand at the head of scientific and skillful navigation of the ocean during the 19th century.

Among the Faraday's navigation appliances was the "Distance-Wire" which gave the exact distance run *over the ground:* a deep-sea sounding wire (No. 20, BWG) was paid out continuously under a carefully regulated strain and in passing over a measuring wheel recorded the run with an accuracy comparable to that of measuring distances in land surveying. Furthermore the "lee-way" could be quite accurately checked by observing the trend of this "ground-log" wire over the stern.

Another feature was the daily noon telegraphic time signal from the Canadian Government observatory at Quebec, which gave the chronometer comparison on the syphon-recorder tape.

On deck no less than nine experienced navigators took sights from early dawn until dark and half-hourly azimuths on the Sir William Thompson compass with its accurate shadow-pin. In sextant work these observers habitually used the long astronomical telescopes in their sextants; these and all other operations were favored by clear weather and a smooth sea in which the 10,000 ton Faraday with her deep bilge-keels and the restraining pull of the cable over the stern rode as steady as the proverbial church. All sights were worked out with 7-place logarithms and a mean of the various positions was accepted after throwing out any which differed a mile from that mean.

But in spite of all these, there came a bright day with a seeming perfect horizon when every "line of position" was bad and although the nine sextants gave the same meridian altitude to within a half minute, yet the noon latitude was nearly three miles north of the line on which the ship was supposed to be. With unfaltering judgment, Mr. Brittle, the cable engineer in charge, held his course and the next day's sights put the ship back on the line which had been laid off two days before.

All these scientific appliances and all the care and skill of these trained navigators had been bowled over by a change in the atmosphere whereby the sea horizon was raised above its normal place, and the actual "Dip of the Horizon" was less than that taken from the "Dip Table."

Having no means of measuring the actual Dip, the sights were all rejected and the location of the cable on the chart was plotted by "dead reckoning" from the "Distance-Wire" records, as if the sun and stars had not been seen that day.

With this experience fresh in mind, the writer conceived the idea of the Navigator's Prism by which the Dip of the Horizon can be measured as readily and twice as accurately as the index-error is taken on the horizon, of using this measured Dip to correct the observed altitude and of thus eliminating a most treacherous element of uncertainty in observations at sea.

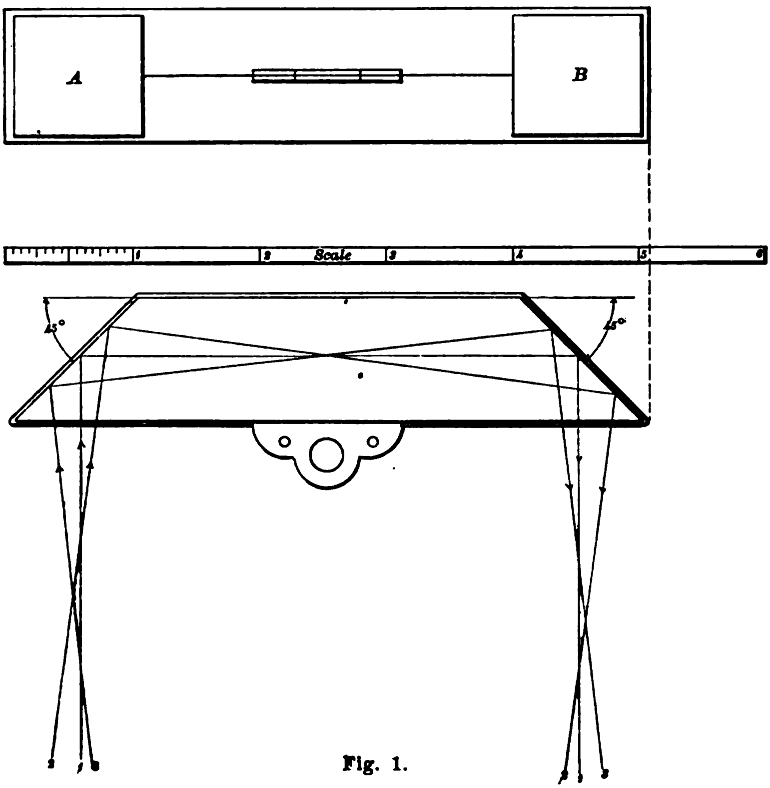


Fig. 1.

The Navigator's Prism is plain glass prism of square section with the end faces bevelled off at angles of 45° with the long axis and at right angles with each other, as shown to scale in Fig. 1.

A ray of light in the plane of the prism, striking as indicated in the figure, is turned through 180 degrees and returns in a path parallel to its first direction.

Held vertically, with the lower bevelled face at the height of

the eye, Fig. 2, the observer sees in the prism the back horizon (inverted) and at the same time sees in front of him (on either side of the prism) the front horizon: the two horizons are separated by the angle of twice the Dip.

To measure this angle with the sextant, the Prism is secured to the sextant so that the lower face is in front of the index-

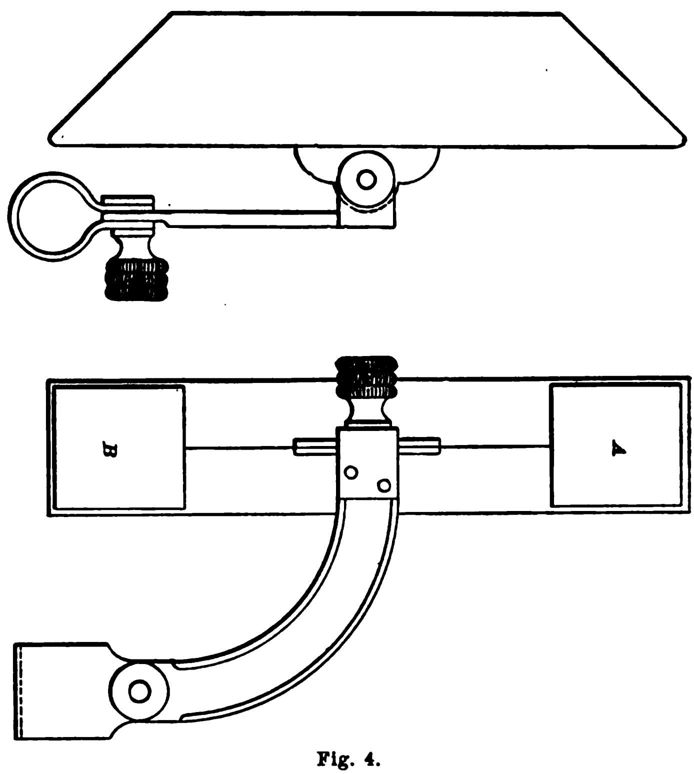


Fig. 4.

glass, Fig. 3, and the index-bar is moved until the direct (front) horizon and the reflected (back) horizon are seen in line: the corrected reading of the sextant is twice the angle of the Dip.

The details of the attachment are shown in Fig. 4. The Prism is protected, except the faces A and B, by a cover of aluminum to which is attached the clamp for securing it to the sextant. The clamp may fit over the upper leg of the sextant (which covers the axial pin of the index-bar) or, if preferred, it

Fig. 2.

Fig. 3.

may fit directly on to the wooden handle so that no additional weight is brought on any part of the frame of the sextant.

It might appear at first glance that any error in the construction of the Prism would be eliminated by taking two observations with the Prisms reversed end for end, but such is not the case since the error would appear in the *same direction* both times. It becomes necessary then to determine the error (if any) in the construction of the Prism. This error, measured by the maker of the Prism, is engraved on it and is bound to remain constant.

To measure the Dip: measure the index correction of the sextant; clamp the Prism to the sextant, and, holding the sextant vertical (as in taking a sight), turn the tangent screw until the reflected and direct horizons are in line; read the sextant and apply the index correction of the sextant and the Prism correction to the reading and divide this corrected angle by two and the result is the angle of the Dip.

To take a sight it is not necessary to take off the Prism for it may be turned back out of the way, as in Fig. 5, leaving the index-glass unobstructed.

The observed altitude is corrected first for index error and then the measured Dip is subtracted and the remaining angle is the observed altitude above the true horizon.

There is no *adjustment* of the Prism to the sextant; this can be shown when the two horizons are seen to be in line, by slacking up the clamps and moving the Prism when, so long as the reflected horizon remains in the field of view, its coincidence with the front horizon is intact. If the Prism were turned about its vertical (long) axis through a considerable angle the horizons would separate but in practice the reflected horizon disappears from the field of view before this separation becomes large enough to be noticed.

DIP TABLES.

The Dip of the Horizon set forth in Table XIV, Bowditch's Practical Navigator, is tabulated from a formula deduced by Chauvenet ("Spherical and Practical Astronomy," Volume I, page 177), and does not differ materially from the Dip Tables in other recognized Epitomes.

The formula is:

$$\text{Dip} = D - .0784\ D$$

$D =$ the Dip of the Horizon, neglecting the atmospheric refraction.

$$D = \sqrt{\frac{2X}{a}}$$

$X =$ the height of the eye of the observer above the water.

$a =$ the radius of the earth.

The determination of D is mathematical and exact, although in practice there may be small errors in the assumed height of the eye due to variations of the draft and trim of the ship and of the position of the observer.

But the refraction coefficient 0.0784 D is deduced from a series of assumptions and ancient experimental data, and at best is supposed to hold only for a mean refractive state of the atmosphere, and many cases of abnormal Dip of the Horizon have been recorded.

The following table sets forth some of the observations of the Dip of the Horizon as measured with the Navigator's Prism by the officers of the U. S. S. Alert.

The Dip is shown to have varied more than *10 minutes* of arc in an interval of 5 days in practically the same place, and this too with only small thermometric and barometric changes.

These observations prove conclusively that the Dip of the Horizon from any given height is variable and that it should be measured at the time of taking a sight: the Navigator's Prism attached to the sextant provides a simple, accurate and handy instrument for this purpose.

Use of the Navigator's Prism in Pilot Waters.

The late Lieutenant-Commander F. R. Brainard, U. S. Navy, in a small volume entitled "Sextant and other Reflecting Mathematical Instruments," Van Nostrand Co., 1881, defined an *Inter-Range* as a line joining two distant objects on which line the observer is located *between* the two objects; this in contradistinction to an ordinary Range when the observer is on the *extension* of the line joining two objects. (See page 75.)

Later on (page 112) he points out that an instrument by which the Dip could be measured would be useful in navigation and

Fig. 5.

surveying by enabling the observer to make use of Inter-Ranges.

This the Navigator's Prism does: held horizontally with one bevelled face in front of the eye, Fig. 6, the observer sees in the Prism the landscape behind him, and at the same time sees ahead of him (above and below the Prism), the front landscape. Each object of the rear landscape appears in the same vertical line with some object in the front landscape and *the observer is on the straight line joining each pair of these objects* which become an Inter-Range.

When an exact Inter-Range has been established the coincidence of the front and rear objects is not altered by turning the Prism on its three axes, nor by moving it bodily in any direction, so long as the reflected object remains in the field of view it remains in coincidence with the front object. If revolved about the line of sight, the reflected field is seen to revolve about the rear object as a center and the reflected horizon appears inclined to the front horizon.

Fig. 7 shows a method of attaching the Prism to a binocular telescope to assist the vision. The bevelled end of the Prism partly covers one object glass and the relative brightness of the direct and reflected landscape is regulated by moving the Prism in the direction of its length, thereby altering the ratio of the covered to the uncovered areas of the object glass. The horizontality of the Prism is secured by turning the clamp about the barrel of the telescope until the reflected horizon is seen parallel to the front horizon.

While observing with this one eye is closed, but the Prism need not be removed for the ordinary use of the binocular because the image produced by the Prism fades away when the direct image is reinforced in brightness by the second barrel of the binocular.

Observations with these are facilitated by pointing the glasses upward with a slight inclination, so that the front horizon appears in the lower part of the field of view with the back horizon showing above its skyline; then by slowly lowering the telescope to the horizontal, the coincidence of the various points of the two pictures is readily observed.

USE OF THE INTER-RANGE IN PILOTING AND SURVEYING.

The exact determination of a ship's being on a line between two points, and the approximate determination of how far she is off that line, have heretofore been so difficult that little attention has been paid to this method of navigation. The use of the Range (by which was always meant two objects lying in the same direction from the observer) has long been well understood, but every two visible objects between which vessels pass, are available as an Inter-Range. It is evident that the occurrence of useful Inter-Ranges is much more frequent in pilot waters than that of useful ordinary Ranges. Especially is this true in chart work where the borders of the shore are presented with accuracy and detail, and afford many pairs of recognizable marks between which ships pass, whereas, on the distant background (where the rear-marks of the ordinary ranges must be sought) it is often difficult or impossible to locate on the chart a rear-mark.

Lieutenant Armistead Rust, U. S. Navy, in an article in the PROCEEDINGS OF THE U. S. NAVAL INSTITUTE, No. 102, June, 1902, on a "Direction Indicator" has shown many of the practical ways of using Inter-Ranges, all of which can be done by the Navigator's Prism which, with its absolute accuracy, its freedom from adjustment and its handiness, is offered as an instrument for the development of this new method of navigation in pilot waters.

Fig. 6.

Fig. 7.

Date.	Time.	Latitude, North.	Longitude, West.	Thermom. Dry.	Thermom. Wet.	Thermom. Surf Water.	Barometer. Aneroid.	Barometer. Therm. Alt's.	Sextant Reading. Observed.	Sextant Reading. Index Correction.	Sextant Reading. True.	Prism Correction.	Two Dip.	True Dip.	Height of Eye.	Dip from Table.	Error of Table. +	Error of Table. −	OBSERVER.	REMARKS.
1901.		° ′	° ′						′ ″	′ ″	′ ″	′ ″	′ ″	′ ″		′ ″	′ ″	′ ″		
Oct. 9	10:50 A	32 50	118 05	62	62	66	30.13	66	12 20	0 00	12 20	−2 25	9 55	4 58	15½	3 52	....	1 06	Ens. D. S. Mahoney.	Overcast—Observer on quarterdeck.
" 9	11:00 A	32 50	118 05	62	62	66	30.13	66	13 40	0 00	13 40	−2 25	11 15	5 38	22⅔	4 40	....	0 58	" "	" Same dip in all azimuths. Observer on bridge.
" 16	1:25 P	32 40	117 20	63	62	67	30.03	68	18 10	0 00	18 10	−2 25	15 45	7 53	22⅔	4 40	....	3 13	" "	Cloudy to Sd. Clear to Nd. Same dip in all azimuths.
" 16	2:30 P	32 42	117 24	62.5	62	67	30.14	67	16 40	0 00	16 40	−2 25	14 15	7 08	22⅔	4 40	. .	2 28	" "	Same, except bright horizon under sun. Same dip in all azimuths.
" 16	3:30 P	32 44	117 31	62	61.5	67	30.13	65	15 20	0 00	15 20	−2 25	12 55	6 28	22⅔	4 40	....	1 48	" "	" " " " " " "
" 17	8:30 A	33 06	117 +	60	59	65	30.15	63	15 40	0 00	15 40	−2 25	13 15	6 38	22⅔	4 40	....	1 58	" "	Overcast, bright horizon under sun. Same dip in all azimuths.
" 17	9:00 A	33 05	117 +	60	59	65	30.17	65	15 20	0 00	15 20	−2 25	12 55	6 28	22⅔	4 40	....	1 48	" "	" " " " " "
" 17	12:30 P	33 +	117 +	64	62	65	30.19	65	16 00	0 00	16 00	−2 25	13 35	6 48	22⅔	4 40	....	2 08	" "	" " " " " "
" 17	3:15 P	33 +	117 +	62	61	64	30.18	65	15 25	+1 30	16 55	−2 25	14 30	7 15	22⅔	4 40	....	2 35	" "	" " " " " "
" 17	3:45 P	33 +	117 +	62	61	64	30.18	64	14 50	+1 30	16 20	−2 25	13 55	6 58	22⅔	4 40	....	2 18	" "	" " " " " "
" 17	4:15 P	33 +	117 +	63	62	64	30.19	66	14 55	+1 00	15 55	−2 25	13 30	6 45	22⅔	4 40	....	2 05	Ens. L. M. Overstreet.	" " " " " "
" 17	4:45 P	33 +	117 +	63	61	64	30.18	66	15 05	+1 00	16 05	−2 25	13 40	6 50	22⅔	4 40	....	2 10	" "	" " " " " "
" 17	5:15 P	33 +	117 +	62	61	64	30.18	66	14 55	+1 00	15 55	−2 25	13 30	6 50	22⅔	4 40	....	2 05	" "	Damp. Overcast, bright horizon under sun. Same dip in all azimuths.
" 21	Noon	32 +	118 +	71	66	66	30.12	81	0 30	−3 00	−2 30	−2 25	−4 55	−2 28	22⅔	4 40	7 08	....	Ens. D. S. Mahoney. Ens. L. M. Overstreet.	Cloudless and hot. Same dip in all azimuths.
22	8:45 A	32 +	118 +	70	66	67	30.10	74	2 30	−3 00	−0 30	−2 25	−2 55	−1 28	22⅔	4 40	6 08	....	Ens. D. S. Mahoney.	Clear and pleasant. Measured in one azimuth only.
22	Noon	32 +	118 +	74	70	67	30.08	77	8 30	−3 00	5 30	−2 25	3 05	1 33	22⅔	4 40	3 07	....	" "	Clear and pleasant. Same dip in all azimuths.
22	3:00 P	32 +	118 +	75	70	67	30.04	75	3 40	−3 00	0 40	−2 25	−1 45	−0 53	22⅔	4 40	5 33	...	" "	Clear. Measured from N. by W. to S. by E. S.W. ½ W.
22	3:35 P	32 +	118 +	75	70	67	30.04	75	10 20	−3 00	+7 20	−2 25	4 55	2 28	22⅔	4 40	2 12	....	" "	Clear. Measured from S.W. to N.E.
" 22	4:00 P	32 +	118 +	75	69	67	30.03	76	10 20	−3 00	7 20	−2 25	4 55	2 28	22⅔	4 40	2 12	....	" "	Clear.
" 23	9:45 A	32 40	117 40	65	63	66	30.16	67	16 35	−3 00	13 35	−2 25	11 10	5 35	22⅔	4 40	....	0 55	" "	Clear. Fog to N.W. Off Point Loma.
" 23	Noon	32 40	117 40	69	68	66	30.14	67	16 25	−3 00	13 25	−2 25	11 00	5 30	22⅔	4 40	....	0 50	" "	Clear. Off Point Loma.

DIP OF THE SEA HORIZON—Continued.

Date.	Time.	Latitude, North.	Longitude, West.	Thermom. Dry.	Thermom. Wet.	Surf Water.	Barometer. Aneroid.	Barometer. Therm. Alt's.	Sextant Reading. Observed.	Sextant Reading. Index Correction.	Sextant Reading. True.	Prism Correction.	Two Dip.	True Dip.	Height of Eye.	Dip from table.	Error of Table. +	Error of Table. −	OBSERVER.	REMARKS.
1901.		° ′	° ′						′ ″	′ ″	′ ″	′ ″	′ ″	′ ″		′ ″	′ ″	′ ″		
Oct. 31	2:55 P	33 +	117 50	66	63	65	30.11	68	15 20	−2 00	13 20	−2 25	10 55	5 28	22⅔	4 40	....	0 48	Ens. D. S. Mahoney.	Clear and pleasant. Off La Jolla. Same dip in all azimuths.
" 31	3:55 P	33 +	117 50	67	64	65	30.11	69	15 20	−2 00	13 20	−2 25	10 55	5 28	22⅔	4 40	....	0 48	" "	" " " " " " "
Nov. 18	4:00 P	32 08	117 05	66	63	64	30.21	68	12 40	0 00	12 40	−2 25	10 15	5 08	22⅔	4 40	....	0 28	" "	Clear and pleasant.
" 19	3:00 P	29 10	116 20	64	61	66	30.19	66	13 00	0 00	13 00	−2 25	10 35	5 18	22⅔	4 40	....	0 38	" "	Cloudy.
Dec. 1	5:00 P	23 04	109 30	77	73	78	30.09	78	9 50	0 20	10 10	−2 25	7 45	3 53	22⅔	4 40	0 47	....	" "	Clear and pleasant.
" 1	5:05 P	23 04	109 30	77	73	78	30.09	78	9 50	0 50	10 40	−2 25	8 15	4 08	22⅔	4 40	0 32	....	Ens. L. M. Overstreet.	" "
" 6	Noon	23 33	111 10	70	68	77	30.12	71	12 10	0 30	12 40	−2 25	10 15	5 08	22⅔	4 40	....	0 28	Ens. D. S. Mahoney.	" "
" 7	8:10 A	25 22	113 09	65	62	73	30.29	68	12 10	0 30	12 40	−2 25	10 15	5 08	22⅔	4 40	....	0 28	" "	Fair. Light clouds.
" 7	3:30 P	25 57	113 50	65	61	68	30.25	68	11 50	0 30	12 20	−2 25	9 55	4 58	22⅔	4 40	....	0 18	" "	Clear and pleasant.
" 15	2:30 P	29 50	115 20	58	54	64	30.23	63	12 20	0 00	12 20	−2 25	9 55	4 58	22⅔	4 40	....	0 18	" "	Clear and pleasant. Off Eros Island.
" 15	2:30 P	29 50	115 20	58	54	64	30.23	63	9 00	0 00	9 00	−2 25	6 35	3 18	15½	3 52	0 34	....	" "	Clear and pleasant. Off Eros Island. Observer on quarterdeck.
" 16	6:25 A	29 50	116 13	59	55	62	30.35	65	12 10	0 00	12 10	−2 25	9 45	4 53	22⅔	4 40	....	0 13	" "	Clear and pleasant.
" 16	10:30 A	30 20	116 20	57	55	62	30.31	61	20 40	0 00	20 40	−2 25	18 15	9 08	80	8 46	....	0 22	" "	Clear and pleasant. Observed from topmast cross-trees.
16	10:30 A	30 20	116 20	57	55	62	30.31	61	16 30	0 00	16 30	−2 25	14 05	7 03	50	6 56	....	0 07	" "	" " " " foretop.
16	10:30 A	30 20	116 20	57	55	62	30.31	61	9 30	0 00	9 30	−2 25	7 05	3 33	15½	3 52	0 19	....	" "	" " " " poop-deck.
[illegible]2. [illegible]y 8	4:50 A	33 10	118 10	55	55	60	29.92	61	10 50	0 00	10 50	−2 25	8 25	4 13	22⅔	4 40	0 27	...	" "	Overcast, cloudy and damp. Off Santa Catalina Island.
8	6:00 A	.....	......	56	56	60	29.93	62	10 30	0 00	10 30	−2 25	8 05	4 03	22⅔	4 40	0 37	....	" "	" " " " " "
" 8	11:30 A	33 13	118 18	59	57	62	29.96	69	13 50	0 00	13 50	−2 25	11 25	5 43	22⅔	4 40	....	1 03	" "	Partly cloudy. Hot sun. Dip same in all azimuths. Off S. Catalina Island.
" 8	3:30 P	33 13	118 18	60	59	63	29.89	65	12 50	0 00	12 50	−2 25	10 25	5 13	22⅔	4 40	...	0 33	" "	High fog, clear around horizon. Dip same in all azimuths. Off S. Catalina Island.
" 14	6:20 A	33 13	118 18	58	55	60	30.07	70	14 10	0 00	14 10	−2 25	11 45	5 53	22⅔	4 40	....	1 13	" "	Dip the same in all azimuths.
" 14	5:15 P	33 13	118 18	65	61	61	30.04	67	14 10	0 00	14 10	−2 25	11 45	5 53	22⅔	4 40	....	1 13	" "	" " " "

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE ERRORS THAT ARISE FROM EXTRAORDINARY DEFLECTION OF RAYS OF LIGHT NEAR THE HORIZON.

By Lieutenant G. W. Logan, U. S. Navy.

It has often been pointed out, in text-books of navigation and elsewhere, that altitudes observed at sea are subject to error when peculiar atmospheric conditions operate to produce an extraordinary deflection of the ray of light from the horizon, and thus to make the actual angle of dip vary from its tabulated value. It is believed that attention can not be too frequently directed to this important subject, for the reason that there are undoubtedly many navigators who do not realize the magnitude of the error that may be involved; some have the impression that this error is such as to throw the results out by no more than a mile or so, and hence may be neglected for all practical purposes; others, while knowing that in the Red Sea and other special localities the error is to be guarded against, do not consider that it need ordinarily be feared by the navigator. It can be demonstrated that this error may attain a value so great as to jeopardize a vessel, even if a very large margin be allowed for inaccuracy of the sights; and that the conditions under which it is produced are such that it may occur in any region of the ocean.

It is possible that the lack of knowledge regarding the error is due to the fact that the reason for its occurrence has not been made sufficiently clear; it is frequently spoken of merely as "excessive refraction due to temperature," and as a glance at the table given in Bowditch and kindred works shows that the correction for temperature to be applied to the refraction is of

small amount, this description does not ordinarily impress the student of navigation. Many explanations have gone further, it is true, and pointed out that a difference in the temperatures of the sea water and the air causes an arrangement of the air in strata of varying temperature and density, to which the error is due; but even this is not a complete description, and remains to be amplified before the full consequences of such an arrangement become apparent. It is proposed to give a full explanation of the extraordinary deflections that occur, in the hope that their frequency and possible magnitude may be better understood.

It may be remarked, by way of preface, that the conditions that produce these deflections are analogous to those under which occurs the phenomenon of *mirage*, so familiar to seamen;

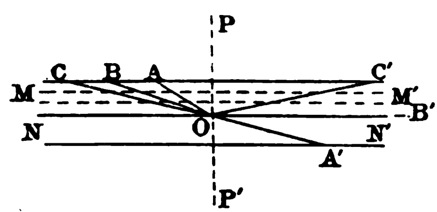


Fig. 1.

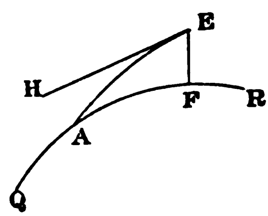


Fig. 2.

and when one considers what great distortion of the rays of light must take place to produce the inverted, duplicate and other extraordinary images of objects seen in a *mirage*, it may be realized how little dependence can be placed upon the position of the sea horizon under similar circumstances.

If, in Fig. 1, MM' and NN' are two media of different density, the former being the more dense, a ray of light, AO, in passing from MM' into NN', will suffer refraction, taking up in the latter medium a new direction, OA', which will make a greater angle with the line PP' (perpendicular to the line of junction between the media) than it made while in MM'. The angle P'OA' will therefore be greater than the angle POA by an amount dependent upon the relative density of the two media. Conversely, a ray, A'O, which passes through the less dense medium, NN', will, in entering MM', take up a new direction, OA, which will make a smaller angle, POA, with the perpendicular

than P'OA', which it made before. Consider, now, a ray BO passing through MM' at such an angle that BOP *plus* the increase due to refraction equals P'OB'; it may be seen that the effect is such as to prevent this ray from entering the medium NN', and it will take up a direction OB' along the line of junction of the media. It is therefore clear that it would be impossible for any ray, CO, making a greater angle than BOP with PP', to penetrate NN', and the fate of such rays is to undergo a total reflection from the line of junction as if that line were a mirror, and to re-enter the denser medium, taking a direction OC, such that the angle COP equals the angle C'OP.

In Fig. 2, let QR represent a small part of the earth's surface; E, the eye of an observer at a height EF above the surface, and A the most distant visible point of the earth's surface; then

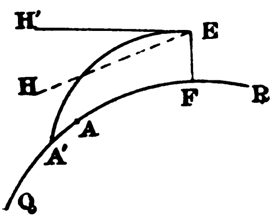


Fig. 3.

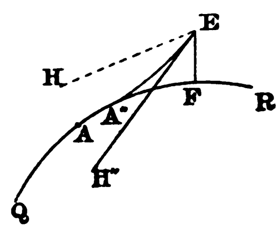


Fig. 4.

the path of the ray of light from A to E under ordinary atmospheric conditions is shown by the curved line AE, which will be concave toward the earth. This is because, under normal conditions, the density of the atmosphere is found to diminish from the surface of the earth upward, as each successive stratum carries less and less weight of air from above; thus the ray of light, in passing from the more to the less dense strata, makes a constantly increasing angle with the perpendiculars to the lines of junction of the layers. The direction in which the horizon then appears to the observer is along the tangent EH to the curve EA, and it is for such apparent directions under normal conditions that tables of dip are computed.

Fig. 3, shows the case of deflection of the ray when the air is very much warmer than the sea, as frequently occurs, for example, in the Red Sea, where the hot air from the desert blows across the cooler water. The stratum of air in immediate

contact with the sea falls in temperature from the effect of the cooler mass, and the strata next above are similarly lowered in temperature, but by a less and less amount as the height increases. This condition increases the difference in density that normally exists, the curve having the same general shape as in the usual state of the atmosphere, but the deflection being more marked; a ray now reaches the observer from the point A', more distant than A; its first direction is comparatively oblique to the surface but it is gradually bent away from the perpendicular until the angle becomes too acute to enter one of the less dense media above and it suffers total reflection, and then curves downward, or toward the perpendicular, as it returns toward the earth through strata of increasing density. The direction in which the observer appears to see the point A' is along the tangent EH', which is above the usual direction EH; if, therefore, an observed altitude be corrected by the amount of the normal dip, the "true" altitude thus obtained will be too small by an amount HEH', and the sight will result in a line of position too far from the body; that is, for example, too far to the southwest if the body bears northeast, or too far to the north if the body bears south. This condition of atmosphere will also affect the visibility of objects, making it possible to see points that would be below the horizon in a normal state and increasing the altitude of objects above the horizon.

In Fig. 4, it is assumed that the sea is warmer than the air, a case that presents itself, for example, to a vessel in the Gulf Stream. In this condition the lower strata of air become more heated and consequently less dense than those above, and the ray of light from the most distant visible point A", to the observer E, suffers refraction in a direction that is convex toward the earth, since it passes through media of increasing density and is therefore bent more and more toward the perpendicular. Under these circumstances the apparent direction of the horizon is along the tangent EH", which is below the normal direction EH; hence, in correcting for dip on the assumption that the horizon lies, as usual, toward EH, the resulting altitude will be too large by an amount HEH", and the resulting line of position will erroneously lie too near to the observed body—too far to the northeast if the body bears northeast, or too far to the south if the body bears south. Another effect of this state of atmos-

phere will be to reduce the visibility of objects, a point which is usually seen from the distance FA, with height of eye EF, now remaining invisible until approached within the distance FA″. The apparent height of an object above the horizon will also be reduced under these circumstances, the direction of the ray that reaches the eye being at first obliquely downward, then suffering total reflection and finally curving upward.

It has been seen that the conditions necessary to produce extraordinary deflections of the rays require that the atmosphere shall arrange itself in a series of horizontal strata of uniformly varying density. It follows, therefore, that the mere difference in temperature between air and water is not sufficient in itself to produce the error, and that any cause that interferes with the formation of strata will prevent the occurrence of the deflection. As wind, by keeping the air in motion, renders the conditions unfavorable for the existence of layers of unequal density, it follows that a light breeze will, in general, greatly reduce the error, and that a strong one will effectually prevent it. Hence it is that the maximum bending of rays is to be expected in calm weather. It seems probable that the stratification is more likely to be disturbed when the air is colder than the sea than in the opposite condition, since the heavier particles are then above the lighter and the atmosphere is in a state of unstable equilibrium that may be easily deranged.

Both theory and experience show that the higher the eye of the observer is placed above sea level the smaller are the deflections from the causes under consideration. It is therefore well, especially when there is reason to suspect the conditions that produce abnormal deflections, to observe altitudes from the highest available position.

One of the most dangerous features of this error is that there is no satisfactory method of arriving at a correct estimate of its amount. If the conditions with which it is necessary to deal were fixed in their nature, such for example, as the mean atmospheric conditions for which the ordinary dip table is computed, it would be a simple matter to arrive, either by theory or experiment, at the amount of the deflection. But the elements of the problem can not, in their nature, be known. For instance, the conditions of temperature and wind at a distance of several miles from the observer, which can not be determined at the

ship, have an important bearing on the solution; so also with the amount of moisture in the air, which is doubtless a material factor. The navigator may, however, recognize the existence of the disturbing conditions and the probable direction in which the disturbance will affect the results of his observations; and with this knowledge he must make ample allowance for possible errors.

In considering the effects of this error, it must be remembered that the dip directly affects the altitude, and the altitude, in turn, the line of position; when an error in altitude occurs, the line of position is correspondingly moved at right angles to its length, either directly toward or away from the observed body. It may be seen at once that the error of the Sumner line due to this cause may be considerably increased, and even magnified a number of times, in the position resulting from the oblique intersection of two lines, or in the longitude corresponding to an assumed latitude, or the latitude corresponding to an assumed longitude.

It may be mentioned that an analogous error can occur in observed horizontal angles where masses of land or other causes create a difference in temperature to right and to left of the observer. This fact is worthy of note in surveying.

From a very large number of recorded instances of abnormal deflections of the rays of light from the horizon, due to inequality of temperature between sea and air, a few will be chosen to illustrate the possible magnitude of this error.

It is related that on one of Captain Cook's voyages the meridian altitude of the sun was being taken when a light snow squall came on. The horizon and sun remaining visible, the altitude shown by the sextant had almost instantly to be altered 32′ to maintain contact, the horizon having appeared to fall by that amount when the air surrounding the observers was cooled by the snow squall. At the same time a distant mountain peak, which before had stood well above the horizon, almost disappeared from view. Both of these effects vanished with the passing of the squall, the measured altitude resuming its former value and the peak rising again above the horizon. Even if we are inclined to doubt the instruments of those times, and therefore the exactness of the observed difference, this account is of interest in showing at how early a day the existence of this error was recognized in navigation.

According to Raper, Mr. Fisher observed in the Arctic regions a variation of 18′ in the place of the horizon.

The late Captain Lecky, in his "Wrinkles," states that on a clear day in midwinter, off the coast of Long Island, five observers at noon closely agreed upon an altitude which gave a certain latitude; in less than two hours afterwards the land was sighted, and the latitude brought forward from the meridian altitude was found to be 14′ in error.

Lieutenant Koss and Ensign Thun-Hohenstein, of the Austrian navy, while conducting observations near Pola for finding the variation in the dip of the horizon, observed on a quiet day a rise of the apparent horizon above its computed position of 8′ 47″ at a height of 50 feet, and of 9′ 23″ at a height of 33 feet above water.

Of the numerous instances that might be cited of extraordinary errors in the results given by astronomical sights in the Red Sea, (so extraordinary as to have given rise to an erroneous belief as to the currents existing in that body of water), it may be mentioned briefly that Lieutenant Marshall, U. S. Navy, of the U. S. S. Detroit, found errors of position from 12′ to 18′ arising from sights of the sun; Captain Nedden, of the S. S. Madeline, found the latitude by observation to differ 10 miles from the correct one and images of islands to be greatly distorted; and Captain Lecky discovered the positions of certain islands to be apparently 7 to 8 miles in error in one direction from morning sights and a similar amount in error in the opposite direction from afternoon sights.

A similar instance of error in the region of the Gulf Stream was reported by Lieutenant Commander W. L. Rodgers, U. S. Navy, of the U. S. S. Lancaster, two lines of position from the sun intersecting at about 7 miles to the southeast of the ship's true position and two from stars intersecting at a like distance in the opposite direction, the direction of the error in each case according with that which was to be expected from the observed differences in temperature of air and water.

As a result of what has been set forth, the following brief summary may be given for the guidance of navigators:

(*a*) The inaccuracy of tables showing the dip and the visibility of objects should always be suspected when there is a marked difference between the temperature of the air and that of the sea water.

(*b*) The errors will be largest in calm weather and when the eye is not far elevated above the sea, and will decrease as the wind increases and the eye is raised.

(*c*) When the air is warmer than the water, the visible horizon is raised above its normal position; the altitude corrected by the ordinary dip table will be too small, and the resulting Sumner line will be farther from the observed body than the true line. An object will be sighted from a greater distance than usual.

(*d*) When the water is warmer than the air, the visible horizon is lowered below its normal position; the altitude corrected by the ordinary dip table will be too large, and the resulting Sumner line will be nearer the observed body than the true line. An object will be sighted from a less distance than usual.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVAL TORPEDO STATION.

By Lieut. Robert W. Henderson, U. S. Navy.

In submitting this article on the Naval Torpedo Station, it is not my intention to deal with the full details of the several departments here, but to consider the station, and the various duties connected with it, as a whole, in order to give the officers of the service, many of whom have never seen the Torpedo Station, a general idea of the work carried on, and its importance to the profession of a naval officer.

The Torpedo Station was established on Goat Island, in the harbor of Newport, in the summer of 1869, occupation of the island by the Navy Department being authorized by the Secretary of War on July 29 of that year. This island, the Indian name of which is "Nanti-Sinonk," was purchased from the Indians May 22, 1658, and was subsequently sold to the Colony of Rhode Island and Providence Plantations by Benedict Arnold.

In 1701, the Assembly voted 150 pounds for the building of a fort on the island, naming the work Fort Anne. In 1730, it became Fort George, to accord with the change of reign in England. In 1774, the Assembly ordered Fort George dismantled and the guns sent to Providence for safety. During the War of the Revolution, it was called Fort Liberty by the Americans, although the English, during their occupation of Newport, retained the old name of Fort George. In 1784, it was named Fort Washington, and in 1798, Fort Wolcott, to commemorate the Revolutionary service of Governor Oliver Wolcott.

During the War of the Rebellion Goat Island was occupied by the Naval Academy. Two frigates, the Constitution and

the Santee, were moored near the shore, and were used as quarters for midshipmen.

At the time of the founding of the Torpedo Station, there were on Goat Island, a one-story building, formerly the army barracks, and a number of small wooden structures, which had been erected for the Naval Academy. The barracks building was utilized for class rooms for officers and for laboratories. What is known as Storehouse No. 2, built of the material obtained from the temporary buildings first mentioned, was used as a storehouse and machine shop. Between 1871 and 1874, the station experienced its greatest material expansion, the storehouses, the machine shop, the cottages for officers, the chemical laboratory, and the electrical laboratory being erected, and the old barracks rebuilt into quarters and offices for the inspector in charge. In 1881, the first gun-cotton factory was built, consisting then of but two small buildings, and a wing was added to the electrical laboratory. The manufacture of explosives required a more extensive magazine, and in 1883, the Navy Department secured a lease of Rose Island from the War Department, paying $150 yearly for it. All the high explosives manufactured at the station are at present kept in the magazines on Rose Island. The powder factory having burned down, in 1896 the new factory, consisting of six buildings, was erected and the manufacture of gun-cotton and smokeless powder is now going on in these buildings. In 1901 the new administration building was completed, the lower floor being used as a storeroom for torpedoes, with offices and a lecture room on the second floor.

The Torpedo Station was instituted with a view of training a number of officers and men (to be called the Torpedo Corps) in the use of torpedoes of all kinds and the necessary accessories. It was the intention that to this place, as headquarters, should be confined the defense by torpedoes of our entire coast. Two years later, by an act of Congress, the general subject of torpedoes was divided, and that part relating to stationary torpedoes (called submarine mines) was assigned to the Engineer Corps of the army. From the moment of its inception, however, the Torpedo Station has been occupied with the experimental solution of a great variety of technical problems affecting naval warfare.

At the present day there are the following departments at the Torpedo Station, each of which will be considered in its turn; executive department, torpedo department, electric department, explosive department, and the department of boats.

The commandant, or inspector in charge, has general supervision of all departments, and of the work going on at the station.

The executive department includes the charge of all the enlisted men of the island with their papers, and the enlistment of all recruits. It also includes the care and preservation of grounds, wharves, buildings, etc., the sanitary condition of the island, the superintending of the laborers' gang, and the directing of all island work. In addition, the executive is senior member of the Torpedo Board and the Board of Inspection. The small duties of the executive of the island are many and varied, and from a professional standpoint his position is probably the least desirable at the station.

The torpedo department is in many respects the most important of the station. Under it comes, first, the repair and overhauling, care and preservation of all torpedoes in the service; second, the preparation of all torpedo outfits for vessels in commission; and, third, the adjusting, testing and running of all torpedoes before issue, and all experimental torpedo work. To perform this duty in a satisfactory manner, it is necessary that the officer in charge familiarize himself with all the details and parts of a torpedo. To do this requires no small amount of labor and time, but once done, the knowledge gained is invaluable from a professional standpoint.

The work of torpedoes and torpedo boats is becoming more and more a factor in modern warfare, and each year is bringing forth some new and important step ahead in the development of each. When the Mark III 3.55 meter torpedo, fitted with the Obry gear, first came into use, it was considered that the torpedo had nearly reached perfection; but when compared with the new 5 meter Mark II, fitted with the superheater and the modified gyroscope, it is as an old-time frigate compared with a modern battleship.

A word as to this latest type of torpedo. Although 5 meters long, and similar to the Mark I in many respects, the new type is fitted with guide studs for both above deck and submerged

tubes. The long war-head of the Mark I's has been discarded and the old Ogival head restored, which puts the center of the explosive charge nearer the object struck, and allows an increase in the capacity of the air flask. Aside from the superheater fitted to the engine, which is as yet in an experimental stage, the new 5 meter torpedoes are being fitted with the modified gyroscope which replaces the old Obry gear. Too much cannot be said in praise of this new gyroscope, which is the result of the joint efforts of Lieut.-Comdr. W. I. Chambers, U. S. N., and Quarterman Machinist Moore of this station. The old spring impulse of the Obry has been done away with, and has been replaced by an air impulse, with pipe connection direct to the air flask. But in addition to keeping the torpedo in a straight course which was done by the Obry, the gyroscope permits of being set for any angle from 0° to 140° to right or left, locking the rudder over until the torpedo has turned through the required angle, after which it directs the torpedo in a straight line. It is an improvement on the Kazelowsky gear, in that once the torpedo is running in a straight line, the control valve has a neutral point, and the rudder is stationary, only moving when the torpedo is deflected, to bring it back to its original course. This alone places the gear ahead of the Kazelowsky, whose rudder is always hard over one way or the other, causing the torpedo to steer a zig-zag course, even though the mean is a straight line. The new gyroscope is well beyond the experimental stage, and its success and general adoption is assured. Experiments are now being conducted at this station to determine the tactical diameter of the 5 meter torpedoes due to the rudder effect of this gear. Once found its importance is seen at a glance, for by setting the three gyroscopes at different determined angles, and firing at the same time by means of the electric attachments, the three torpedoes can be made to approach the enemy—running parallel courses, at ship's length apart, so that escape from all is practically impossible.

The electrical department owes its importance to the fact that at present it is supplying the entire service with new electric firing attachments. This is a combination battery box, with attachments for firing and electric night sights from the same battery. This department furnishes electric attachments, terminals, firing keys, battery boxes and plugs to all vessels in

commission. Under it is the primer and fuze room, manufacturing about 2500 combination primers per week. A close inspection of the new Tobin bronze combination electric and percussion primer now manufactured at this station will repay those who are interested in ordnance improvement.

The manufacture of mines, countermines and dummy mine outfits also comes under the electrical department. Dummy mine outfits, consisting of the mine case, exploder, pattern "D" torpedo (not loaded), releasing detonator, patent any depth anchor, battery and wiring, are furnished to all the larger ships of the service. All buildings of the station are lighted by electricity, and in the dynamo room are four dynamos of different type, and two new Rand electric air compressors. The running of these machines is a part of the electrical education given at the station. The wireless telegraphy plant is at present in an experimental stage. Messages have been sent across the room of the electrical laboratory, but experiments are at a standstill, pending the erection of a wireless plant on Montauk Point.

The explosive department consists of the powder factory and the magazines on Rose Island. The powder factory is composed of six buildings, situated on the water front in rear of the chemical laboratory, and both gun-cotton and smokeless powder are manufactured. When made, the gun-cotton is pressed into square blocks, and these are taken to Rose Island where they are kept stored at the navy standard of 25 per cent moisture. When needed for filling war-heads, the necessary amount of cotton is brought to the station, and when a war-head is filled it is stamped with its weight and sent back to Rose Island, where it is kept until the torpedo is issued to the service.

In brief, smokeless powder, of which gun-cotton is practically the base, is made as follows: The cotton is carefully picked and dried, then nitrated for 30 minutes in a mixture of sulphuric and nitric acids. It is then washed and boiled for six hours at 100° C., changing the water every two hours. The cotton is then removed to the pulper, where it is chopped and shredded between knife blades for a period of from five to fifteen hours, depending upon the texture of the cotton. It is then poached, or boiled, for a period of twelve hours, with frequent washings and changing of water, while a paddle wheel constantly stirs the pulpy mass, after which it is run off, and, if it stands the heat test,

it is wrung dry in a centrifugal wringer. After the cotton has been dehydrated it is thoroughly treated with a mixture of ether and alcohol; strained; pressed; run through the proper die; cut; and is ready for drying. After removal from the dry house the powder is tested ballistically, on Rose Island, and if satisfactory it is stored in air-tight receptacles in the magazines until sufficient quantity is on hand for a blend, when it is sent to the Naval Magazines, Iona Island, by public conveyance.

In the development of Navy smokeless powder several officers have devoted much attention, especial credit being due Lieut.-Comdr. J. B. Bernadou, U. S. N., for his untiring efforts in that direction.

The following boats are assigned regularly to the station for torpedo work and instruction: Dahlgren, Craven, Morris, McKee, Stiletto and Nos. 1 and 2 auxiliary boats of the old Maine. The Morris has been used constantly for experimental torpedo work, and her excellent condition at present is a good proof of the advisability of keeping the torpedo boats in running condition to preserve them. There is at present at this station an engineers' class of instruction, consisting of coal passers and 2d class machinists, and this class is taken out on the different boats for instruction in water tube boilers and high powered engines. The increase in the number of torpedo boats afloat makes such a class of instruction indispensable to the efficiency of the torpedo service.

In addition to the class of coal passers and machinists just mentioned, there is a class of seamen gunners at the station for instruction in torpedoes, electricity and diving. A gunner has charge of this class and they are given a routine course in torpedoes, practical work in the dynamo room, and practice in diving. Once graduated from the seamen gunners class the men are eligible for gunners-mate's ratings, and also add the sum of two dollars a month to their regular pay.

By far the most important of the classes for instruction is the class for the instruction of officers in torpedoes and electricity. This course of instruction is of necessity varied with the number of officers sent for instruction and the duration of their stay.

Officers coming here for a regular summer course are taken

up with the following schedule of work, the first part consisting of lectures, and the second part of practical work:

Day.	Sec.	Topic.		Sec.	Topic.
1....	1, 2....	Whitehead Torpedo.		3, 4....	Dynamos, Motors, etc.
2....	1, 2....	do	do	3, 4....	Electric Instruments.
3....	1, 2....	do	do	3, 4 ...	3-Wire System.
4....	1, 2....	do	do	3, 4....	Wireless Telegraphy.
5....	1, 2....	do	do	3, 4....	Naval Defense Mine.
6....	1, 2....	Howell.	do	3, 4....	Countermines.
7....	1, 2....	do	do	3, 4....	Air Compressors, etc.
8....	1, 2....	do	do	3, 4....	Means of Firing.
9....	1, 2....	Gun-cotton.		3, 4....	Gun-cotton.
10....	1, 2....	Smokeless Powder.		3, 4....	Smokeless Powder.
11....	1, 2....	Practical: Factories.		3, 4....	Library Work.
12....	1, 2....	Lecture: Explosives.		3, 4...	Lecture: Explosives.

In the afternoon the two sections exchange order of work.

PRACTICAL.

Five days shop work with Whitehead torpedoes; assembling: war-nose; immersion gear; engine; valve group; steering engine; Obry gear; making adjustments, etc.

Fifteen days torpedo boat work; handling boats; firing torpedoes; working air compressors; torpedo target practice; use of director.

Ten days practical electricity: care of dynamos; locating faults; practice with instruments; running motors; 3-wire system; wireless telegraphy.

Four days naval defense mines: assembling and planting.

Two days Howell torpedo.

Two days Schwartzkoff torpedo.

However, during the recent summer, the station has been badly crippled with lack of officers, and the demand for more officers for sea duty has been such that only three or four were sent here for instruction during the entire summer. Last fall a number of officers reported from the North Atlantic squadron, and they were given a course of instruction according to the following schedule:

Section A.—Those who have had torpedoes before.

Sections B and C.—Those who have never had torpedo instruction.

SECTION "A" (6 WEEKS).

General review of all marks of torpedoes (shop work)..1 week.
Obry gear; new steering device; installing same.......1 week.
Running 3.55 Mark III, and torpedo work (McKee)....1 week.
5 meter Mark I with new gyroscope (Morris).........1 week.
Air compressors, electric attachments, and mines......1 week.
Explosives, powder factory and review ....1 week.

SECTIONS "B" AND "C" (6 WEEKS).

Assembling, overhauling and adjusting all marks of torpedoes ....2 weeks.
Other weeks to take up the course as above..........4 weeks.

The extent of knowledge gained here in the study of torpedoes and electricity depends entirely upon the amount of interest taken in the work; for with every facility for practical work here at the station, an officer has every opportunity to acquire the most minute details of torpedo work and electricity.

The importance of the work done at the Naval Torpedo Station since its establishment is most evident. The development of the automobile torpedo has been done here entirely, and the work of developing the new steering device has progressed from experiment to assured success through the efforts of the various officers assigned to the work.

The navy smokeless powder, developed by certain naval officers in the face of opposition, is another achievement, and the station's usefulness to the service is beyond description.

The torpedo boat and the torpedo boat destroyer are becoming more and more a factor in modern warfare. The command of these smaller craft has been given to the younger officers of the service, and no finer training can be had than the responsibility, self-reliance and confidence that comes from the handling of a boat that is tearing through the water at the rate of from 25 to 30 knots per hour. Unfortunately the progress of torpedo boats has been hampered by a peculiar condition of affairs. The older officers in the service, who have the rank and experience necessary to gain influence in their behalf, are usually so far above the command of one of these small craft that it is difficult to secure their attention and enthusiasm in that direction.

The younger officers, who are all energy and zeal in behalf of the torpedo boats, unfortunately lack the rank and experience necessary to gain for the boats their just deserts.

Then, too, the boats have been badly crippled by being limited in their operations by time and directions.

During the torpedo boat manœuvres, the boats are sent out to sea with instructions to attack on a specified night, and within certain hours. Then the big battleships, with searchlights going, and all hands lined along the rail, proudly proclaim that no torpedo boat could creep into range and escape their vigilance. Let the squadron be off a port, and let the torpedo boats put to sea with liberty to attack at any time within a five day limit, and a different story will result.

Not only will the suspense and nervous strain for those on board the big ships be far greater, but also more than one of the battleships will be put out of action before the little fellows are all destroyed. Those who were in the Santiago blockade can testify as to the constant vigilance and watch required, with the knowledge that two of the enemy's torpedo boats were in the harbor waiting a chance to attack.

The development of the dirigible torpedo and the submarine, and the increase of speed in the torpedo boats, will make the position of a blockading fleet very uncomfortable, if not untenable, in the days of future warfare.

The actual amount of work accomplished by the Naval Torpedo Station has been so great, and of such vast importance to the naval service, that we can but hope that the present plans for still further enlarging and improving the station will be met with every encouragement from the entire service; and that the torpedo work of the future will vie with that of the past in reflecting credit and glory upon all officers of the navy, who, by their energy and devotion to duty, have made the Naval Torpedo Station what it is to-day.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SINGLE DISPLAY TACTICAL SIGNALS.

By Lieut. H. C. Mustin, U. S. Navy.

Last October the writer of this submitted to the commander-in-chief of the North Atlantic fleet plans for a system by which all tactical signals may be made by a single display. This system may be used without making any change whatever in the rules of signaling now in use and does not require learning a new code. The addition to the apparatus now in use being an efficient four-arm semaphore and four pulsators in the Ardois keyboard instead of one.

There are in the navy a few officers who advocate the adoption of the two-arm semaphore, such as used in the British and German navies. My greatest objection to the two-arm semaphore is that it cannot be applied to the proposed single display system, but there are other serious defects in it.

It is not possible to arrange this semaphore so that displays can be read in all directions at once; the reading is limited to one direction, or two if the displays are read backwards. Therefore it is not efficient for tactical signals of any kind.

The code used is different from the Myer code, which is used throughout all our own systems, except the flags, and it has two characters less.

The code cannot be represented by any form of night signals so that knowledge of more than one code will always be required if it is adopted.

For word messages the two-arm semaphore has a reputation for great rapidity, but it must be remembered that the rapid signaling of the British is done with their small semaphores at the bridge ends. The size and weight of the mast-head sema-

phores prohibit rapidity of operating, which is the reason for the existence of the small ones. So it is only convenient for rapid signaling at short distances and in one direction. (Reading displays backwards violates the principle of rapid reading of signals.) A two-arm semaphore carried at the truck, if of large enough size to be used at long distances, cannot, on account of its weak support, be used in a high wind, and even when not in operation they have been known to come down from aloft in the British service.

Its code when applied to the hand semaphores gives a little more rapid method than the wig-wag system with the Myer code. But this advantage is outweighed by the facts that the wig-wag system may be used at night with a torch or searchlight, the same code can be used in a fog with a whistle, and a wig-wag signal can be sent from behind a trench or any kind of protection without the least exposure to the signalman. In sending a hand semaphore signal, all the vital parts of the signalman must be exposed. The army is not likely to adopt such a system and if we do, we must still have signalmen proficient in the wig-wag code so that our means of communication with the army will not be lost.

The writer has been experimenting with various forms of semaphores since 1897, when Lieutenant-Commander Fiske's four-arm semaphore was installed on the New York for trial, and has always considered that an efficient semaphore must approach as nearly as possible the advantages of the Ardois night system, while exceeding it in range of visibility. The best system in use for all-around efficiency is the four-light Ardois; for general (and tactical) signals, the answering of displays by their repetition reduces the chances of error in reading; in word messages, where the displays are not repeated, a greater speed is attainable than in any other visual system; the displays can be read in all directions at once, except the small arc that may be masked by the topmast; the one disadvantage is the rather short range of visibility, but this can be much improved by using higher power marine glasses and increasing the candle power of the lights. There are advantages in any semaphore over flags; a semaphore is not affected by the direction or lack of wind, nor by the position of the sun, and if constructed of a suitable size, exceeds the flags in

range of visibility. Besides it may be used at that period of time, dawn or twilight, when it is too dark to distinguish the colors in the flags and too light to see the lights of the Ardois. For word messages (Telegraphic Dictionary) flag signals are hopelessly slow.

As a result of the experiments and keeping to the qualifications mentioned above, the writer this summer submitted to the commander-in-chief of the North Atlantic fleet plans for a four-arm semaphore which were approved and recommended for trial by the fleet signal board, and its construction for trial recommended by the general board. This semaphore may be called a modification of the Fiske semaphore as it has four arms and is designed to be read from any direction, but in other respects it is different. There is not space for a detailed description with drawings, but the following will explain the general ideas of the system.

It is a four-arm semaphore of two elements, so the Myer code is applied, and it is used in the same manner and for all signals made by the Ardois.

It is operated by eight suction magnets connected up to the Ardois light leading wires, so that the same keyboard is used for semaphore and Ardois; the advantages of one keyboard which can be used in a protected place, for both night and day signals, are obvious.

The elements are a long and narrow arm, "2," and a shorter and broader arm, "1." In each element there are about sixteen square feet of surface, so the range of visibility will be greater than that of any day system we now have and will be about that of the British mast-head semaphore.

A display on the topmast will have the appearance of a succession of military tops; the element "1" appearing as a deep-sided top of rather small diameter and the element "2" appearing as a shallow-sided top of large diameter; the semaphore being carried well above the ship's tops, a display will not get confused with them. The distance at which it is possible to distinguish the tops of a ship gives a good idea of the visibility of the system. The displays are read from the upper element down as in the Ardois.

An element has exactly the same appearance from every direction; this is effected by having three arms or vanes to each

element carried on shafts set at angles of 120° in azimuth; the same shafts carry the vanes of the other element.

To attain speed in transmitting and at the same time make the arms of adequate size, it was found necessary to reject any form of arm that is pivoted on the end or in the center. It is impossible on account of the inertia of such arms, if they are large, to operate them rapidly. The arms or vanes in this system when in the "off" position lie in the horizontal plane with their edges only appearing. To display an element the vanes are rotated about their longitudinal axes through an angle of 90° into the vertical plane. As the shafts are fixed, and no part of a vane is at a great distance from its supporting points, the vanes may be constructed lighter than any equal sized pivoted arm, and as the amount of motion is much smaller, they may be operated very rapidly.

Another advantage of this form of arm is that in pulsating an element, the arm moves from its "on" to "off" position and back again without passing through a position which may have a different signification; as is the case in pulsating a semaphore in which the elements are represented by angular positions of an arm.

The parts of this apparatus which are carried aloft can be constructed so that they are not too heavy, although the arms are large; for the arms will not interfere with two shrouds and a stay and the weights and pressures are distributed on the topmast instead of being concentrated at the truck as is the case with a two-arm semaphore. The construction is much simpler than would appear from this brief description. On account of the clear method of pulsating, long range of visibility, greater speed, the more convenient method of operating, and because an element actually has the same appearance in all directions, the semaphore described above will be superior to other semaphores for general use and particularly for the proposed system of single display signals, a description of which now follows.

The Tactical Signal Book now used contains 229 signal numbers; to make any of 118 of these we require by day a three-flag hoist and by night six displays on the Ardois (not counting the signal of execution); for any one of 101 of them we require a two-flag hoist or five displays on the Ardois; for any one of

the remaining ten, we require a one-flag hoist or four displays of the Ardois.

Using the four-arm semaphore by day and the Ardois by night, both operated by a keyboard with four pulsators, we can make any one of these signals by a single display. We now pulsate the upper light of the Ardois for all numerals, so there is no reason why other lights of a display should not be pulsated as long as there is always at least one steady light in the display to prevent confusing it with a ship's or division's call which is flashed.

It would appear that this would entail learning a new code of a great number of characters, but this is obviated by the form of the proposed tactical signal book.

With four pulsations the following displays are possible:

30 unpulsated displays: the alphabet and the displays "cornet," "letters," "interval" and "code call," the last four and "I" and "T" have special significations, which leaves 24 available for signals.

28 displays with the upper element pulsated: the alphabet (except "I" and "T") and the displays "cornet," "letters," "interval" and "code call;" of these all have special significations except the numerals, which leaves 10 available.

28 displays with the second element pulsated: the same as the preceding, all of which are available.

24 displays with the third element pulsated: all displays but those of one and two elements "I," "T," "A," "E," "O," "N."

24 with the first and second elements pulsated: the same as the preceding.

24 with the first and third elements pulsated: the same.

24 with the second and third elements pulsated: the same.

16 with the fourth element pulsated: all the four element displays; "B," "F," "G," "J," "K," "M," "P," "O," "V," "W," "X," "Z," "cornet," "letters," "interval" and "code call."

16 with the first and fourth elements pulsated: the same as the preceding.

16 with the second and fourth pulsated: the same.

16 with the third and fourth pulsated: the same.

16 with the first, second and third pulsated: the same.

16 with the first, second and fourth pulsated: the same.
16 with the first, third and fourth pulsated: the same.
16 with the second, third and fourth pulsated: the same.

Thus it is possible to make 310 different displays; of these 24 now have special significations, viz.:

"A" (first pulsated)=Cipher A use.
"C" (first pulsated)=Repeat.
"D" (first pulsated)=Telegraphic dictionary use.
"E" (first pulsated)=Error.
"H" (first pulsated)=Compass signals use.
"K" (first pulsated)=Negative.
"L" (first pulsated)=Geographical list use.
"N" (first pulsated)=Cipher B use.
"O" (first pulsated)=Cipher C use.
"P" (first pulsated)=Affirmative.
"Q" (first pulsated)=Interrogatory.
"R" (first pulsated)=International code use.
"S" (first pulsated)=General signals use.
"U" (first pulsated)=Navy list use.
"W" (first pulsated=Annulling.
"X" (first pulsated)=Numerals.
"Y" (first pulsated)=Vessels numbers use.
"Letters"=Word message.
"Interval" (first pulsated)=Boat signals use.
"Interval"=Division point, date, designator.
"Cornet"=General call, signal of execution.
"Code call."
"T" (at night)=Engines making prescribed speed.
"I" (at night)=Engines stopped.

This leaves 286 displays available for signals by which we can make all signals in the present tactical signal book and will have left 64 additional for any new manœuvres that may be adopted.

The proposed tactical signal book is to consist of four pages, with no cover; two leaves of a stiff material that is impervious to weather, and just heavy enough to sink; the leaves are folded either way, and carried folded it is always open to half the book, so will be much handier than the book now used.

On each page are four vertical spaces: in these spaces are printed the signal numbers and their meanings; the signals

being grouped in columns as they are grouped under headings in the present book, for convenience in sending.

Opposite each space in a column is the name and illustration of a display, beginning at the top with the letters of the alphabet in order except "I" and "T," and ending at the bottom with "cornet," "letters," "interval," "code call," in order.

At the head of each column will be printed in large type the number or numbers which show which element or elements of a display are pulsated. For instance, at the head of the first column, page one, will be "*unpulsated,*" showing that any signal in that column is made by the display shown opposite its space without pulsating any element. At the head of column four, page one, will be "*3rd,*" showing that any signal in that column is made by the display shown opposite its space with the third element pulsated.

The last column on page four contains no signals, but has a compass table like that in use now.

The appended drawing of a portion of a page will show the method of using the book.

RULES.

1. All signals in the tactical signal book shall be made without a code call; the absence of a code call showing that a tactical signal has been displayed and that there will be but one display, before the signal of execution. (Except as provided in rule 4, or in case it is to be annulled, or in case a compass or numeral signal is required after it.)

2. Tactical signals to the whole force shall be made without a general call.

3. Tactical signals to one or a few ships shall be preceded by flashing their call letters; the ship or ships concerned alone shall answer their calls and the signal.

4. Tactical signals to the whole force except one or a few ships shall be made in the same manner as to the whole force; before turning on the signal of execution, flash the calls of the ships excused, which shall answer their calls but shall not answer the signal of execution.

If it is desired to make a tactical signal by any other method

than the single display system, follow the rules now laid down in the introduction to the general signal book, using the signal numbers found in the spaces of the proposed tactical signal book.

Sending.

Find the signal to be sent in the column in which its class is grouped, turn on the display shown opposite its space and pulsate the element or elements designated at the head of the column in which it is found. (The pulsations should be made deliberately, and, if more than one element is pulsated, they should be pulsated together.) When answered by the whole force, with proper display and proper pulsations, turn off and make the signal of execution if the signal is one requiring a change of formation, course, speed, order, distance or interval, or a drill signal. (If not to the whole force follow rules 3 or 4.)

Receiving.

Note the display and the numbers of the elements pulsated. Refer to the column which is headed by these numbers and in the space opposite the display shown will be found the signal. When read and understood answer with proper display and pulsations.

Examples.

Flagship wishes to make signal to the whole force, "Ships right about." Turn on "G" and pulsate third element; when answered by all, make signal of execution.

Flagship wishes to make signal to Alabama (L), "Stop!" Flash "L" until answered; turn on "F" and pulsate second element; when answered by Alabama, make signal of execution.

Flagship wishes to make signal, "Steam at reserved speed," to whole force except Kearsarge (K). Turn on "E" and pulsate second element; when answered by whole force, flash "K" until answered by Kearsarge; then make signal of execution.

To show the saving in time we will make the first of these examples by the present method at night.

Flagship makes "cornet;" when answered by the whole force, makes "S" and pulsates upper element; when answered by whole force, makes "M," upper element pulsated; when answered by whole force, makes "M," upper light pulsated; when answered by whole force makes "interval;" when answered by whole force, makes signal of execution. Here are five displays instead of one, before the signal of execution.

By the proposed system it is apparent that all chances of error in reading are eliminated, for the meaning of a signal is complete in one display and is answered by the same complete signal.

Thus we will have the two most important requirements for tactical and battle signals, reliability and quickness. Besides there is the convenience and simplicity in making them and the fact that the signalman need not be exposed in action. In case of failure of the apparatus in action we have all of the present systems to fall back on, which can be done without confusion as the proposed system involves no change in the present rules or methods.

This system was investigated and recommended for trial by a board of officers in the North Atlantic fleet. Its application to night signals can be made at a small expense, involving only the installing of four pulsators in the Ardois cable, which can be done by the ship's force.

		2nd			3rd
		Speed.			Changes of Course and Front.
o o*	A	75. Speed, Slow, Steam at.			
o •* • o	B	76. Speed, Half, Steam at.	o • •* o	B	95. Ships right half turn.
• o* •	C	77. Speed, Standard, Steam at.	• o •*	C	96. Ships left half turn.
o o* o	D	78. Speed, Full, Steam at.	o o o*	D	97. Ships right.
• o*	E	79. Speed, Reserve, Steam at.			
o o* o •	F	80. STOP!	o o o* •	F	98. Ships left.
o o* • •	G	81. BACK!	o o •* •	G	99. Ships right about.
• o* o	H	82. Speed—Make all possible with boilers in use.	• o o*	H	00. Ships left about.
• •* o o	J	83. Speed—Increase a little to keep station.	• • o* o	J	01. Column right.
o •* o •	K	84. Speed—Decrease a little to keep station.	o • o* •	K	02. Column left.
o o* •	L	85. Speed—Observe more carefully.	o o •*	L	03. Countermarch, head of column right about.
•	M	86. Speed—Indicated.	•	M	04. Countermarch.

NOTE.—The numbers shown here are not the same as those in the present tactical signal book, it being confidential. It will be seen that in the proposed book we have a means of making cipher code signals by a re-arrangement of the order of signals in a column, or of the numbers at the head of a column, or both.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A PLEA FOR A PERMANENT REGIMENTAL FORMATION IN THE UNITED STATES MARINE CORPS.

By Captain Henry C. Davis, U. S. Marines.

For many years there has lain dormant in the minds of many marine officers the hope that some one would some time be courageous enough to bring forth and push through a scheme for organizing the Marine Corps on a basis of regiments, battalions and companies.

I would not presume to offer such a scheme while there are so many officers of higher rank who are so much more capable of doing it, yet I have such a scheme in mind and I am one of those who some day hope to see such an organization.

The idea of this article is to point out what, to my mind, are some of the advantages of such an organization, with the hope that it may awaken serious thought on the subject throughout the Marine Corps. I do not think I am exaggerating when I say that the esprit de corps in the Marine Corps is higher than in any other branch of the United States service, both among officers and the enlisted force.

How much higher then could this esprit de corps be brought when men have the traditions of their companies, battalions and regiments to look back on.

Nothing so stimulates efficiency as a keen rivalry between men working for the same object. The efficiency of the Marine Corps could in my opinion be vastly increased where the permanent company formation would give men the chance to serve always under the same officers and non-commissioned officers, and to work with these officers for the perfection of their immediate organization.

While I was on duty at the barracks at Mare Island, one of my commanding officers allowed me to form the command into a four company battalion with the view of a permanent company formation, as far as possible. The rooms of the barracks were apportioned to the four companies and the experiment formed a source of great gratification to me, for it had hardly been in operation twenty-four hours when the good effects began to be felt. In fact, while the change was being made it was necessary to move nearly every man in the barracks; the men could be heard hustling so and so in order that "B" Co. could get into its new quarters. The whole spirit of the men was thrown into the experiment and every day when company drill was held by the company officers, a function which the officer of the day had previously been called on to perform, the men could be heard chaffing each other about the poor drill of some company and hoping that some day the poor company would drill as well as "A," "B," "C" or "D" Co., according to the one in which the joker was.

Thus I contend that the spirit of striving to bring up the standard of their own company is keener where men know that they will always be with that company, than when they do not know what day they may be individually sent to the ends of the earth.

This experiment proved itself eminently successful and I mention it to show how the men were anxious to do their best for their companies even though, as they knew, it was only a formation which held in that barracks and that alone.

Take the example of the column led by Major Waller across Samar; it is an evident fact to my mind that those men who suffered together and saw their comrades die and their officers sick and wounded, were drawn closer together by that experience than troops that had never had such an one. Then if those men could know that they would always be known as belonging to such and such company—"One that Waller led across Samar"—I maintain that their morale is raised and the tradition of the way they faced that grave danger would become a heritage of the company and one which would be carefully guarded that it might not be smirched. Such traditions handed down from time to time would make every man feel proud of his organization and its record and when men are made to feel

pride in something which affects them very closely, that something is in good hands and care will be taken that the record is not sullied. And consequently their best efforts will be put forth for the advancement and increased efficiency of that organization.

What man of the Marine Corps is there to-day who would not be proud to point to the battalion which landed at Guantanamo Bay and fought off vastly superior numbers of the enemy for one hundred hours, if that battalion were to-day a permanent organization and had most of those men in its ranks, instead of being scattered from Manila to Porto Rico and from Bremerton to Dry Tortugas? We still love to think of that battalion, but it is only a memory of a brave band who did their duty well and their tradition is held sacred by the Marine Corps, but how much better it would be to see those stalwart men, brought closer together by their baptism of fire, marching along and be able to point to them as a tangible something and tell their record?

It has been my experience, on the two ships in which I have cruised, that the guards of ships are better drilled and more efficient in their duties than marines ashore, and I earnestly believe that it is due to nothing more or less than the fact that they are thrown together for three years with the same officers and the only changes which occur are those which would happen in any company due to sickness, desertion, etc. These men get to know their officers and the officers get to know their men, and this is responsible for much good, for when an officer does not get a chance to know his men he cannot hope for the results which would be obtained if he did.

Now if we take the examples of regiments of our own and foreign armies where men look with great pride upon their regimental badges and their regimental traditions, where men look forward, when about to "take on" again, to being with old comrades and the same officers, why should we not have a similar organization, which is quite possible, where a similar spirit would be fostered?

I do not mean to say that the men do not take just as much pride in being in the Marine Corps as other soldiers do in being in their different regiments, but to my mind many men who do not re-enlist in the Marine Corps would do so if they knew

that they were going back to the same bunkie, the same officers and the same company, battalion and regiment.

It is hoped that the above remarks may start serious thought going to the consummation of such an organization and it is hoped that such a scheme will be discussed, for nothing is so good as discussion for the stimulation of effort. If a chain of thought is started in the minds of men capable of perfecting such organization the writer will feel himself amply repaid and highly flattered, and if such a change is made he will have that pleasant feeling of a hope realized.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE STOWAGE OF THE LARGER CALIBRES OF FIXED AMMUNITION.

By Midshipman Alfred G. Howe, U. S. N.

This article is not in any way intended as a suggestion of a new idea, or as a complete outline of the proposed plan of stowage. There seems to be a very general dissatisfaction with the method at present employed in stowing the larger calibres of fixed ammunition for rapid-fire guns in wooden boxes, but the dissatisfaction seems to have produced no results. It is hoped that a general discussion of this subject might accomplish the perfection of some system of stowage that would bring about the results needed.

It is admitted that there are several advantages in the present system of stowage. There seem to be three prominent advantages in the system of enclosing the ammunition in a wooden box. The ammunition is easy to handle in getting it on board ship and into the magazines, it is easy to label and paint the boxes so that the character of the enclosed shell is known at a glance, and the ammunition is protected from any injury that might result from careless handling.

These advantages are easily disposed of by the advocates of a different system. The question of ammunition supply ordinarily is not how rapidly the ammunition can be gotten aboard, but *how fast it can safely be delivered to the guns.* Leaving out chance, in a battle between equal ships equally expert in shooting, the victory would assuredly go to the ship that could safely keep her guns constantly supplied with the necessary amount of ammunition. It seems that no remarkable amount of ingenuity would be required to compensate for the advantage of

having the color of the boxes indicate the character of the contained shell. The problem of painting or marking the cartridges themselves should not be difficult of solution. The protection from injury by careless handling is a real and decided advantage gained by the system of having the ammunition boxed, but the principle that all ammunition requires the most careful handling should render this protection unnecessary.

On the other hand, there are many and grave disadvantages in the stowage of ammunition in boxes. The question of the extra stowage space required for the encasing boards becomes very important when the quantity of rapid-fire ammunition required in action by a ship is carefully considered. The two greatest objections to the use of the encasing wooden boxes are so closely and unavoidably allied that they may best be treated as one: a very considerable amount of time is necessarily consumed by the shellman in getting the cartridges out of their casings, and there is the real and ever present danger from having loose pieces of wood in an exposed position on a deck exposed to hostile gun-fire. Even if the possibility of having only one boxed shell on deck at a time could for a moment be considered, there is danger during the time necessary to cut the lashings and throw the wood overboard.

It being out of the question to take the cartridges out of the boxes in the magazines, especially in small ships, the question arises as to how the ammunition can be stowed so that it may be delivered to the gun positions ready for use.

It is attempted to solve the problem in the following manner: Let the cartridges be stowed horizontally in racks especially built to accommodate them. To use a specific case, let us consider the four inch ammunition.

Allowing for the extra size of the flange at the base of the cartridge, it seems that a circular hole 4¾ inches in diameter should be a sufficiently large space to accommodate a 4 inch cartridge. This space is intended to include a ⅛ inch steel diaphragm extending longitudinally between vertical rows of cartridges to the skin of the ship or to a bulkhead as the case may be. Two objections to this method of stowage at once present themselves. If the cartridge is not sufficiently supported there might be danger of its becoming bowed; and in

a seaway damage might result to the ammunition from the motion of the ship.

Considering these objections in the order stated, it seems that if the cartridge were supported at the base of the cartridge case, about the middle of the case, and at the base of the shell, with the nose of the shell fitting into a small circular hole in a thin diaphragm or bulkhead, no injury to the cartridge could arise from this source. If the nose of the shell do fit into a small hole in a diaphragm, as suggested above, and a gate be made to close against the base of the brass case, the cartridge would be held rigidly in position in spite of a vessel's motion in a seaway. Any motion of the ship in a plane perpendicular to the length of the cartridge could be prevented from injuring the ammunition by having the circular space in which the middle of the cartridge rests cut out in a sufficient part of the circumference of a circle to give a good grip on the cartridge. Supposing then, the cartridges to be stowed in horizontal rows, it would be necessary to get a gate quickly out of the way of the row next below after the ammunition in the upper row had been exhausted. In order to accomplish the two purposes of quickly moving a gate out of the way and of fixing the base of a cartridge firmly in position while the ship is in a seaway, it is suggested that the gate be secured in position by a moderately strong spring catch. These catches would probably be needed at intervals of four or five feet, and to safely secure the catches it would be necessary to place vertical bulkheads of somewhat more than ⅛ inch thickness at this distance apart, and to increase the width of the edge near the gate sufficiently to allow the securing of the spring catch. As a precautionary measure, it would be necessary to have small depressions in the gate in rear of the caps.

The extra steel diaphragms or bulkheads might slightly increase the original weight of the magazines, but the advantages claimed for this system are a greater ammunition supply in the same magazine space, and the sending of the cartridges to the guns *ready for use* without unnecessary work for the shellman, and the risk of flying splinters.

This problem has been solved in some foreign navies; why should it not be solved in ours?

DISCUSSION.

"The Signal Question Once More." See No. 103.

Lieutenant-Commander Bradley A. Fiske, U. S. Navy.—In reading the lecture of Lieutenant-Commander Niblack, published in the Proceedings for September, 1902, and the subsequent discussion published in the Proceedings for December, 1902, I notice that there is a broad difference of statement in regard to the working of the British semaphore, in the sense that some officers speak of it as very rapid, and others as very slow.

Perhaps I may be permitted to say that I have found the same difference in the statements of officers with whom I have talked, and to point out that the difference is caused by the fact that those officers who speak of the British semaphore as fast, refer to the little apparatus which is placed on the bridges of many British warships, and which is used for signaling over short distances only; while those who speak of the British semaphore as slow, refer to the very heavy apparatus which is placed at the masthead of some large British warships, and which is used for signaling over long distances. The short-distance British semaphore is fast, for the reason that the parts are light and small; the long-distance British semaphore is slow, for the reason that the parts have to be strong and heavy, and have to be moved by strong and heavy mechanism, since the arms are pivoted at one end, and the pressure of the wind binds them on their pivots.

Referring to the British hand-semaphore, and to the discussion as to its relative advantages, compared with our wig-wag flags, I would like to emphasize the fact that its distance of readability is small, and that the signalman is exposed. One great military advantage of our wig-wag is that a man can get behind anything, and wave anything above it, without exposing himself.

Referring to the relative advantages of flags and semaphores generally, it would seem, from the views of the officers expressed in the Proceedings, that we ought to adopt some semaphore at once, even if we do not adopt the best: because any semaphore is better than flags.

Naturally, I think the four-arm semaphore better than the British, or I would not have invented it; for I knew all about the British semaphore before I invented the four-arm semaphore. My ideal when starting to design a day-signal-system was a day-signal that could be read in all directions, at every instant. That was the thing I aimed at. In working my way along, I found that some form of *semaphore* was the most practical device. I then hit on the idea of making the semaphore arms in pairs that should move in planes perpendicular to each other, so as to show in all directions. Then I made four pairs of arms, so that the day system would be like the electric night system. I then (this was in 1896) thought the invention complete, but when I tried to move the arms in

the wind, I found that the pressure of the wind bound them on their pivots so hard that they could not be moved nearly fast enough. I then pivoted the arms in the middle, so as to balance the wind pressures on all sides of the pivot, and I then found that the wind, even in a strong gale, did not affect them at all. I also found, then, that I could make the arms very light, and yet strong. Those that have been in the Alabama and Kearsarge more than two years weigh only 15 pounds each.

I think the relative advantages of the British and the four-arm semaphores are fairly shown in the following table:

RELATIVE ADVANTAGES OF BRITISH AND "4-ARM" SEMAPHORE SYSTEMS.

Points of comparison.	System having the advantage.	Remarks.
Speed of signaling.	4-Arm.	Very important.
Simplicity of construction.	British.	Very important, but neither system is complicated.
Distance of readability.	?	Difference slight, since either can be read 10 miles or more.
Directions in which can be read any instant.	4-Arm.	Of commanding importance, since at a critical time it may be necessary to signal to ships bearing in various directions.
Freedom from obscuration by smoke.	British.	Difference slight, because smoke obscures either only when it is trailing aft and rising to a certain height, and because 15 feet additional height will equalize obscuration.
Freedom from influence of weather.	4-Arm.	Difference slight; neither is affected much by weather.
Ease of working.	4-Arm.	Not very important.
Freedom from derangement.	?	Very important, but neither is liable to derangement, unless neglected very much.
Freedom from mistakes in sending.	4-Arm.	Difference slight.
Freedom from mistakes in reading.	4-Arm.	Difference slight, if British semaphore is read from a favorable direction.
Adaptability to present U. S. systems of signaling.	4-Arm.	Very important.
Lightness.	4-Arm.	Not important, except in small ships.
Variety of ways in which can be used.	4-Arm.	Extremely important. At a critical time it may be necessary to send a General Signal, a Battle Signal, or "Letters" to distant ships, or shore stations.

An important point of advantage of the four-arm semaphore is that, even if the entire apparatus be deranged or shot away except one pair of arms and the line going from them to the deck, signals of all kinds can nevertheless be made, by simply wig-wagging on that line. In fact, the signaling that can be done in this way is so good, that I have sometimes, in moments of discouragement, seriously considered the idea of abandoning

all the apparatus except the top pair of arms, and the line going from them to the deck.

It is true that "Letters" are not so much needed as Tactical Signals, but how easy it is to provide both Tactical Signals and "Letters" which can be used with the semaphore, the Ardois and flags, if only alphabetical flags be adopted, like the single-flag battle-signals proposed by Lieutenant-Commander Roy C. Smith, in the PROCEEDINGS for December, 1902! It is merely necessary to order that Tactical Signals shall not be preceded by any display, that the signal of execution shall be the pulsation of the first and second arms (or lights) during the last display of the signal, and to print a Tactical Signal Book, in which there shall be 26 pages of signals, 27 signals to a page, making $26 \times 27 = 702$ Tactical Signals in all.

The first page might begin:

A=Open fire (Battle Signal).
A A = Course North.
A B = Course N. ¼ E.
A C = Course N. ½ E.
A D = Course N. ¾ E.
&c., &c., &c.
A Z = Course E. N. E. ¼ E.

The second page might begin:

B=Charge (Battle Signal).
B A = Course E. N. E. ½ E.
B B = Course E. N. E. ¾ E.
&c., &c., &c.
B Z = Course S. E. ¾ S.

The third page might begin:

C=Head of column Right (Battle Signal).
C A = Course S. E. by S.
C B = Course S. S. E. ¾ E.
C C = Course S. S. E. ½ E.
&c., &c., &c.

The sixth page might begin:

F = Ships left (Battle Signal).
F A = Form line of bearing, guide ship bearing North.
F B = Form line of bearing, guide ship bearing N. ¼ E.
&c., &c., &c.

The tenth page might begin.

J = Ships right about (Battle Signal).
J A = Course and line of bearing North.
J B = Course and line of bearing N. ¼ E., &c., &c., &c.

In this book, each page would be headed by a Battle Signal needing only one display.

To make signals for Course, Line of Bearing, and for Course and Line of Bearing combined (column), would require $3 \times 128 = 384$ signals, supposing the Courses and Lines of Bearing to be signaled in quarter-points as at present. This would leave $702 - 384 = 318$ Tactical Signals,

which are more than enough, even if some "Scouting Signals" be added to the Tactical Signal Book. And the tactical advantages of being able to make *in one signal* such compass signals as those indicated above, will be obvious to any one who has had recent experience in Naval Tactics, especially when it is remembered that the maximum number of displays is two, that each display takes not more than five seconds, that it is repeatable, and that the plan can be carried out equally well with semaphores, electric-night-signals and two-flag hoists. Personally, I think this co-working very important, because the semaphore may be shot away, and flags should be substitutable at once. It is for great emergencies, especially, that means for prompt action must be provided.

Of course, this plan can be carried further, and signals of three displays used, and I am personally in favor of such a plan, and suggested a scheme for doing it in the PROCEEDINGS for December, 1902. But I think this part of the signal question is not very important, and that there is no use in talking and thinking very much about it, because the present system of signals is practically good enough for every purpose, except that of actually maneuvering a large fleet. For piping down wash clothes, making Preparatory Signals, and for general routine fleet-work, the present system is sufficient. Let us not worry about that now, but devote our attention to what is urgently required.

The military value of a means of signaling "Letters" among a large fleet, however, should not be underrated, and, as an instance, I beg to recall to the minds of the officers who served in Dewey's fleet in Manila Bay, especially during the time when the fleet was large, and was distributed in various directions over a large area, say about January, 1899, the fact that nearly every evening after dark, the Olympia's electric night signals got to work, signaling *in all directions* orders and information by "Letters" which it had been impossible to signal during the day time. But now in the North Atlantic Fleet, especially at sea, Admiral Higginson uses the Kearsarge's four-arm semaphore at least once in the daytime on the average, for sending "Letters," over long distances to the ships of his command, which frequently bear in many directions from his flagship.

A noteworthy instance of the value of "all-around" signaling occurred a short time ago, when the flagship was leading a column of eight battleships, and began making a long "Letters" signal with the four-arm semaphore. The message was about half done, when she executed a counter march to the right. The other ships in the column followed her, and the message was not completed until all had finished the countermarch. The consequence was that every ship began reading the signal, when she was astern of the flagship, and finished it when she was again astern; but in the meantime she had been on the starboard quarter of the flagship, on the starboard beam, on the starboard bow, on the starboard beam and then on the starboard quarter, and yet the sending and reading of the message had not been delayed or interfered with in the slightest. The speed of the signaling was about eleven characters per minute, which is about the average speed, using the mechanically operated semaphores in the Kearsarge and Alabama.

When it is remembered that this sort of signaling has been done over a distance of six miles in ordinary weather, how can one imagine that the condition of the "Signal Question" is such as to cause us any acute mental anguish, or necessitate any radical "reforms"?

I find that it is not generally known in our navy that the German navy has used for many years a semaphore system for making Tactical Signals that is not unlike the four-arm semaphore system, and is also readable in all directions. The principal differences are that three pairs of arms are used instead of four pairs, and that the arms, being pivoted at the upper end like the British, are hard to operate, especially in a strong wind, and have to be moved by heavy mechanism, with the result that they work slowly, too slowly for signaling effectively, especially "Letters." In my humble opinion, the German semaphore is much better than the British semaphore, very much better.

It may be pointed out here that one of the distinct advantages of this plan of Tactical Signals is that it can be used with one arm of the semaphore, a lantern and shutter, or even a wig-wag flag, in case the semaphore apparatus or the electric night signals be deranged, or the signal haliards be shot away. For instance, suppose it be desired to signal *F A*. It is merely necessary to pull on the line that moves any semaphore arm, so as to make 2221—22—3, or to wink the truck light, or to work the shutter of any lamp fitted with one, or to wave a wig-wag flag. It may be objected that if any letter were wig-wagged that happened to be a ship's call letter, one could not tell whether a Tactical Signal or a Call Letter was intended. To obviate this trouble, it would simply be necessary to follow the same plan as suggested above with reference to the semaphore and the Ardois, and direct that Tactical Signals should not be preceded by any display, but that all other signals should be so preceded; for instance, that the Call Letter of a ship should be preceded by "Ship's Number."

But, to my mind, *the one phase of the signal question that transcends in importance all the other phases, is that of the protection of the signalmen,* because our present system of signaling, if the signalmen are protected, will be much more efficient in battle than the most perfect that the imagination can conceive, if the men who are needed to operate it are left to be shot down on an exposed bridge.

"THE MANEUVERS BETWEEN THE NAVY AND THE COAST ARTILLERY." See No. 104.

Major J. A. LUNDEEN, Artillery Corps, U. S. Army.—I wish to submit a few remarks concerning the part played by Fort Wetherill, R. I., in the maneuvers between the navy and the coast artillery, and to correct one or two errors in the otherwise very interesting and valuable paper.

By looking at the map of the eastern entrance to Narragansett Bay it is seen that Fort Wetherill is situated on the west side of the channel, about 5000 yards inside of Beaver Tail Light, and commands this entrance perfectly, while Fort Adams is about 1500 yards further to the rear and on the other side.

It was found that the four searchlights installed at this fort were not large enough or powerful enough to illuminate a vessel and enable it to be seen at night from the fire commander's station at a greater range than about 6000 yards, and this only under favorable conditions, but that by an observer out near Beaver Tail a vessel could be clearly seen much further out when the lights at Fort Wetherill were directed on it.

To take advantage of this fact the fire commander at Wetherill posted a scout boat just inside Beaver Tail every night during the week of the maneuvers to give warning of the approach of the hostile fleet.

This boat gave notice of the approach of the warships, on the night of September 5, fifteen minutes before the leading ship got opposite to Beaver Tail light, so that their approach was not at all in the nature of a surprise, as is intimated in the paper. The leading ship, the Brooklyn, was distinguished through the telescope of the range finder at the fire commander's station and two ranges were deliberately taken and sent to the guns in time for the first shot from the 12-inch guns to be fired at the Brooklyn when she was 5000 yards away and she was declared out of action before she reached within 2500 yards of this battery. Each of the five ships that entered were fired at in turn and all but one (the Massachusetts) were put out of action, under the rules, by gun fire from this fort alone. I do not know where the author got the idea that the Fort Wetherill searchlights were kept stationary, unless it was from the fact that one of the Fort Adams lights was usually kept so, but the facts are that two of these lights at a time were kept directed on the mouth of the harbor, the left hand one slowly sweeping over the left hand half and the other over the right hand half of the entrance, as that had been found by experiment to be the most effective way. During the attack they were all controlled from the fire commander's station and directed on the particular ship to be fired at.

The ships did not find or blind the fire commander's station by means of their searchlights, being evidently confused by the fire from a new battery on the hill, where two 15-pdr. guns had been mounted just before, and the existence of which was evidently unknown to the navy.

The Peoria was seen entering the harbor on the night of September 4 and 5, but as she had no guns visible and showed no sign of being an enemy, but looked more like a yacht, she was not fired upon by Fort Wetherill. Private yachts and vessels of all kinds were entering and going out of this harbor at all times of day and night, none of which were molested or fired upon by us. In case of actual war none would, of course, be allowed to enter unchallenged after nightfall.

In order to distinguish some of the smaller vessels of the attacking squadron from private yachts, the fire commander at Fort Wetherill submitted a communication before the week of the manuevers, asking that those of them that looked like private yachts or tugboats be made to display some distinguishing signal showing their characters.

I consider that the practical lessons taught the coast artillery by these maneuvers were of very great value, both during the preparations for them, during the week of watchfulness, and during the actual attack.

Major John McClellan, U. S. Artillery Corps.—I have read with much interest the paper on Manuevers between the Army and Navy which took place in September last, and think that the statement of this proposition is most excellent.

I would like, however, to make a correction. It is stated that, during the attack on Fort Adams on the afternoon of September 5, 1902, Fort Greble delivered its fire on the battleships Kearsarge and Alabama. This is a mistake. Fort Greble could not see the battleships nor other vessels of the fleet operating against Fort Adams except while they were beyond the range of its guns.

When the Brooklyn and Olympia parted from the fleet and proceeded towards Narragansett Pier, they came within range of the mortars and 10-inch rifles of Fort Greble and were promptly put out of action by Fort Greble.

Had the fire commander at Fort Adams needed assistance, he could have sent Fort Greble the azimuth and range of the battleships, having which, Fort Greble could have delivered an effective plunging fire on the fleet, which at the time was hidden entirely from the view of our observing stations beyond Fort Adams.

As a matter of fact, the fire of Fort Greble mentioned in your paper and also in Major Wisser's article in the Military Service Institution, as having been delivered on the Kearsarge and Alabama in the afternoon attack on Fort Adams, was part of the fire of this fort on those ships and others of the fleet *attacking Fort Adams that night as they ran past into the eastern channel.*

This matter is important as bearing upon the discussion of the so-called dead angle outside of Fort Adams.

That the Brooklyn and Olympia should have come to anchor at a range of about 10,000 yards from, and in plain view of, the heavy batteries at Forts Greble and Wetherill seems inexplicable. It was suicidal, a serious mistake.

The maneuvers were a most useful lesson and experience to us of the coast artillery, and I only regret that the fleet did not make a direct attack upon Fort Greble, as at that post we had at all times a most efficient guard and observers and an excellent searchlight service, as was shown by the manner in which the Peoria was discovered and put out of action in the western channel on the night of September 4.

Captain John K. Cree, Artillery Corps, U. S. Army.—There is very little that I would add to the paper on the Maneuvers between the Navy and Coast Artillery, by Major Wisser, as I am of the opinion that it presents the artillery side of the question very fairly. Only on one or two points is there anything I could add. They are as follows:

Page 797, the conditions of the two sides: At all the forts in the district of New London, and, it is believed, in the district of Narragansett, the fire control systems had barely been turned over to the troops on the day the maneuvers opened. None of the officers or men had had an opportunity of drilling with them until about August 30. It was therefore

impossible that the systems should obtain results at all to be compared to what would have resulted if a reasonable amount of drill with the systems could have been held. The same should be said of the systems of searchlights. The maneuvers developed the fact that the lights were very badly located, in most cases. No opportunity was allowed for searchlight drill before the maneuvers opened, and the want of proper drill was several times demonstrated, as well as the necessity for stronger power lights.

Page 807, Run Past the Race. Day Attack and Bombardment of Fort H. G. Wright: The fleet was at no time out of sight from the observing station on Prospect Hill during this whole movement. The plan of attack adopted—by approaching Fort H. G. Wright from the east under cover of Mount Prospect—had been foreseen and provided for, by locating a range finder on that point. In addition to the ships being seen through the gap north of Mount Prospect, ranges were sent to the fire commander from that station for the use of the mortar battery. The statement near the bottom of page 808, that the admiral was successful in getting within minimum mortar range before he was discovered is therefore incorrect.

The bombardment of Fort H. G. Wright from the rear, during the later stage of this engagement, could have no effect on the guns of the post, as they are completely concealed from reverse fire, and on account of the high ground to the northeast of the post, all shots fired from that position would have passed completely over the fort.

These "comments" are of such slight importance as to be hardly worth publication, but are submitted in accordance with your request, and may be used if considered worth while.

Major H. A. Reed, Artillery Corps, U. S. Army.—It is a pleasure to note in this paper the appreciation of a fact so apparent probably to all who took part in the army and navy maneuvers, that the command of the defenses of so important a point as the entrance of Long Island Sound should be under the command of a general officer of artillery. It is only necessary to consider the values at stake of persons and property to decide that not only a most intimate knowledge of the means of defense is required, but also that the increased rank is commensurate with responsibility involved. A general would surely command the forces defending a land attack on New York. Why should not this obtain if the attack is by sea, when the damage to be avoided is even prospectively greater?

And for an admiral to be opposed in this great game by a colonel would seem at least a trifle discourteous to the former.

A comment on the condition of the coast artillery before and during the maneuvers: Most of the men and many of the officers had had no previous experience in the service of modern guns and appliances; therefore during the entire month of August there was very little rest from drill and other preparations; and, in the six days of the maneuvers, as there were but two reliefs, the strains of endurance attributed to the navy were duplicated in the army. There was actually less strain during the fighting than in the long hours of watching for the enemy, and the latter gave no sign as to which city would be attacked first.

As to "Plans of Campaign," it would be difficult to exaggerate in describing the present ineffectiveness of Fort Michie in preventing a "run by" of an enemy's fleet, especially with weather or darkness favoring the attempt, as well as its exposure to enfilade and reverse fire from any point W. of a N. and S. line. With its most important location and a naturally fine site for a powerful armament to resist attempts of this kind, its present condition is a most apt illustration of the tendency of our self-satisfied nation not to prepare for war in time of peace.

As time of sighting and opening fire is mentioned in "Run Past Through the Race," it is proper to note that on September 1-2, Fort Michie was the first to sight the fleet (its searchlights were the first thrown on the vessels) and to open fire on the same, notwithstanding the fact that its No. 5 searchlight, a 60-inch, which covered the arc of approach, was extinguished through faulty machinery at the time, No. 2, its neighbor, thus having double duty to perform. Again on the 3d, in the morning, Michie fired several rounds before Wright began. In each of these cases, however, Michie had the advantage of position as to both observation and field of fire; in the first, Michie and the fleet were close to each other and in line with Terry's guns; and in the second, the fleet was outside of Wright's sector of fire, at least for his guns; both of which conditions further illustrate the value of Michie as a site for a powerful armament.

According to "points," many of the fleet were put out by Michie, but it is likely that actual service would have developed obstacles to such results—foggy weather, darkness, greater speed of vessels, etc., not to mention the possibility of the system of "points" having favored the army.

The question of who won, however, did not enter our minds; the entire affair was a partial solution of the problem how best to improve our seacoast defenses, and if the lessons thus learned are taken to heart and applied, this country will reap a lasting benefit.

"The Training of Landsmen." See No. 104.

Lieutenant-Commander Geo. R. Clark, U. S. Navy.—I fully agree with the writer's views, (1) on the necessity of a preliminary training in barracks, (2) the length of the cruise, (3) the type of ship, (4) the uselessness of lectures, (5) the desirableness of having open decks, with the men under observation, and (6) the great importance of having the training-ships liberally officered, and the complement of men and petty officers of the very best type, kept full. Article 949, U. S. Navy Regulations, provides for this, and should be strictly enforced.

I do not share the writer's lament over the number of officers and the expense required. The end justifies the means. Nor do I think an officer should undertake, personally and directly, the instruction of thirty-five men. General Order No. 114, of November 17, 1902, prescribing squad instruction on board ship, with the aid of the Recruits Handy Book and P. O. Drill Book, is the best thing that has happened in the navy for years. It is a step, a big step, in the right direction. It has been in operation on board this ship only a short time, but has given most excellent results. It

is "double action" in its work, and benefits the P. O. instructor as well as the boy. The commissioned officer who sits down on deck, counts the buttons on a boy's trousers, and consults him about the fit of his shoes, cannot expect, when later he clothes himself with dignity and gives orders from the bridge, the attention and obedience that would have been his had he left these details to a petty officer. This alternating current of dignity and familiarity is sure to develop a short circuit.

It is a most excellent suggestion "to place the whole subject of training of the enlisted personnel in the hands of a board of officers for study and recommendation," and to "establish an office of Naval Training under the Bureau of Navigation." "Like master like man!" When the officers and men see that the importance of the Training Service is recognized and this new dignity added to it, good results will immediately follow.

This work cannot be done too soon. We cannot in the next "unpleasantness" hurriedly gather men from the harvest fields and machine shops, clothe them in blue, tag them with rates, and expect them to hold together. The only naval duel lost in the War of 1812 was due, not to the ship, but to the raw crew that Lawrence led forth to battle on that fatal day in June.

Lieutenant E. W. Eberle, U. S. Navy.—I have read with much interest Lieutenant-Commander H. S. Knapp's paper on the "Training of Landsmen," and many of his ideas would prove valuable to the service, if adopted, but I do not agree with his ideas of a training-ship for landsmen.

I do not believe in our present system of training landsmen, as I consider it obsolete. We would better face the new conditions now than later on, and boldly break away from the square-rigged vessels for training, and adopt a system in keeping with the naval advancement of the day. In the past, the first requirement of a man-of-war's man was to be a *thorough seaman*, and the second was to be a *good man in a gunner's crew*, while ability as a mechanic was a side issue of little moment. To-day, the first requirement is to be a *good man at the gun*, which includes expert marksmanship, thorough knowledge of gun and mount, mechanical ability, cool-headedness, activity, courage, and resourcefulness; the second requirement is to be an able seaman, which includes knowledge of compass, buoys, lights, wind, weather, and tides, a practical experience as helmsman, leadsman, oarsman, and in handling boats under sail, while ability as a topman or topgallant-yardsman is a side issue of little consequence.

It is admitted that "training on board a square-rigger under sail does make men active, strong and quick to respond, and cultivates intelligence, courage, and resourcefulness," but these essential qualities can be put into our men by another system of training, and at the same time we shall develop their mechanical qualities and accustom them to the intricate mechanism of a modern man-of-war.

A few years ago, I believed that our men should be trained in sailing ships or in full-rigged steamers, but since then my experience with the training of landsmen in battleships has caused me to change my ideas.

Surely experience is our best teacher, and results cannot be controverted. When the Oregon was commissioned in San Francisco in 1896, it was impossible, on account of the Klondike rush, to get our complement of seamen and ordinary seamen. Consequently, we were compelled to fill our vacancies with landsmen. These boys came from California, Oregon and Washington, and many of them had never seen a man-of-war. At the end of eighteen months, these landsmen had developed into well-trained men-o'-warsmen, and a little later they proved their true worth under the severe test of war.

When the Indiana was assigned to duty as a training ship for landsmen, she received about 290 landsmen from the Lancaster and Topeka. These two vessels were stationed at Port Royal and had been training these landsmen for about four months. When these men were sent on board the Indiana, they were in good condition to receive advanced training; they took hold very readily, and quickly accustomed themselves to the new surroundings. Their only discontent seemed to come from their frequent shifts from ship to ship, the Indiana being the third ship within six months, and eight months later they were transferred from the Indiana. At the end of eight months these landsmen made a fairly good crew; they were obedient, bright, energetic, and eager to learn, and had they remained on board for a year, I feel confident that the Indiana would have had an efficient crew. The development of these landsmen on this battleship was remarkable in many ways, and at the end of six months some of them were filling the billets of gunners' mates, coxwains, signalmen, and electricians, and doing the duties very satisfactorily. They could handle and care for turrets and turret machinery, they could handle boats under oars or sail, heave the lead, steer the ship, knot and splice, and above all, many of them could shoot straight and quick with a Krag rifle or a 6-pdr. Better results would have been obtained in the Indiana had we been given 150 landsmen instead of 290, and had our complement of petty officers and seamen been filled. I do not believe in using battleships or cruisers as training ships, but I do believe *that one-third of the complement of each ship in commission should be made up of landsmen that have had six months training at a training station.*

We haven't the time, ships, or officers to make "deep-water square-rigged sailors" of our landsmen, and I would question the wisdom of such a policy if we had the time, the ships and the officers. However, we do want our men to have a fair knowledge of handling small vessels under sail, and we do want them to be expert oarsmen, helmsmen, and leadsmen, and above all to shoot quick and straight, and be thoroughly familiar with their guns. To acquire these results, I would establish large, well-equipped training stations (away from navy yards and large cities), two on the Atlantic Coast, one on the Lakes, and two on the Pacific Coast, having in view a moderate climate, good waters for sailing, and ample ground for drills and rifle ranges. At these stations I would moor ships of the Prairie class, or large army transports. I would send the landsmen direct to these ships from the recruiting stations, quarter them on board and accustom them to ship life and routine.

They would be exercised in work aloft, pulling and sailing boats, infantry, artillery, athletic games, at rifle and revolver practice, and at gun drills. I would have two small brigs, two small steamers, and a few torpedo-boats attached to each station, and I would keep these vessels going at all times with detachments of landsmen, teaching them to sail, to steer, to heave the lead, to keep lookout, to handle anchor gear, and to become familiar with buoys, lights, weather conditions, tides, etc. Much time should be devoted to infantry and artillery drills on shore, and some time to small-arm target practice.

Men showing inaptitude should be discharged, and all others should be transferred to cruising ships or torpedo-boats after spending six months at the training station; but never send to a ship a draft of landsmen exceeding in number one-third of her complement. A divisional officer cannot, in addition to his other ship's duties, train properly more than thirty landsmen. This condition does not obtain on board our training ships with their large crews of landsmen and small complements of officers and petty officers; but by having only one-third of each man-of-war's complement made up of landsmen, we can accomplish good results.

For example, consider a battleship: assign to her 150 landsmen from the training station. This will give 30 landsmen to each of the five line divisions, and the divisional officers, midshipmen, petty officers and trained seamen will break in these new men in very short order. At the end of one year, these landsmen should develop into well-trained ordinary seamen. When landsmen are promoted or vacancies occur on board a cruising ship, that ship becomes available for additional landsmen to fill all vacancies up to one-third her complement.

Transfers from a cruising ship should never be permitted except for urgent reasons, and at the end of a three years' cruise a ship should have a very efficient crew, and many of the men should be qualified for promotion to petty officers' billets on board ships ready for commission. Thus we would educate our petty officers in the *school of practical experience on board modern men-of-war.*

In order to be efficient, every ship in the service must keep up its *drills* or *training*, by whichever word you wish to call it, and therefore a recruit would imbibe more knowledge in a man-of-war than in these converted training vessels where large numbers of landsmen are crowded together with few officers and petty officers to drill them.

Under our present system, recruits are sent first to a receiving ship, where they are drilled, then to a training ship, and finally to a man-of-war. All these changes occur during the first year of enlistment, and in each of the three ships the men find different conditions. It is this frequent shifting and accustoming themselves to the conditons of different ships during the first year that makes the landsmen discontented, and you will hear officers of cruising ships say that they are compelled to begin the training anew. These difficulties will be avoided if, after six months at a training station, the recruit is sent to a man-of-war for his full cruise.

When recruits are sent on board ship for their first cruise, they are happier, have much better spirit, and have better opportunity to learn, if they are sent to a cruising man-of-war.

At the present time we are suffering from a shortage of officers and petty officers in all our ships. By abolishing our large number of training ships, our other ships could be provided with full complement of officers and petty officers, and our torpedo-boats could be commissioned for training purposes, and certainly there is no better school than torpedo-boat experience.

Competition is absolutely necessary to encourage and develop new men, and this is lacking in our present training service where each ship goes off on its independent itinerary and has no ship for competitor or rival.

If we must hold to our present system, let us hope for an organized training squadron under a flag officer; then the ships will be kept together, the men will be happier, and a spirit of competition between ships can be built up to develop the better qualities of our men.

The detail of special men as signalmen is a step forward, and I hope a permanent signal corps will be established in the near future—a corps of expert signalmen, from which men we shall select our quartermasters. An unreliable signalman is worse than none at all, and to get expert signalmen we must have a permanent corps.

I hope, also, to see the lectures or so-called *instruction* reduced to a minimum on board ship; nothing irritates and discourages men so much as this oral instruction, and it is time wasted. Keep the men busy at practical work and at drills, and they will learn cheerfully and quickly, for certainly practical experience is the best teacher.

This all-important question of training men for the new conditions found on board the modern battleship and cruiser has been met by the British navy in an up-to-date manner, by *abolishing masted ships for training purposes.* I hope to see a similar system adopted for our navy, otherwise we shall be left behind in the development of a modern personnel.

Lieutenant J. R. P. PRINGLE, U. S. Navy.—It is with considerable reluctance that I accede to the Institute's request for a criticism of Lieutenant-Commander Knapp's article, as my knowledge of the landsman training service is derived from observation, from conversations with officers serving in that service, and from following with great interest the discussion that has recently been carried on through the medium of the Institute, but not from actual experience.

The knowledge thus gained, coupled with that gained during a period of nearly three years in the apprentice service, has, however, convinced me that there are certain features of the training that must be given a recruit, and certain ways and means of giving him those features, which must be identical, no matter whether the recruit be a landsman or an apprentice, and it is from the standpoint of that belief that what follows is offered.

There are many points of the system as outlined by Mr. Knapp which seem to me to be correct and there are a few which seem to admit of argument.

Having given the recruit the preliminary training in barracks, the next step in the system consists in giving him his sea training, and the question that arises is that concerning the type of ship on which he shall be trained.

The object of this part of the training is, as stated, to accustom the recruit to ship life and ship work and make of him a "seaman." The all-important element of time enters very largely into this question, as it does into every other affecting the training, and I am of the opinion that sails should be done away with once for all. Sail drill develops activity and courage, but it takes up time that could be much better employed in other directions, and it certainly does not give to the recruit any knowledge which he is likely to need when transferred to the general service.

Steamers liberally supplied with boats, and with gymnastic apparatus, and having an itinerary so arranged as to permit of the greatest amount of use of them, will probably send the recruit to the general service in quite as good physical condition as will the ship with masts and yards.

There is no intention on my part to belittle the value of a thorough seaman, but as Mr. Knapp very truly says, "the expert topman is unattainable except under prohibitive conditions," and, that being the case, it seems to me that we had better expend our energies along other lines than those necessary to produce him. The only sail drill that seems to me to be necessary or advisable is a sufficient amount of exercise at reefing to insure its being done properly in case of necessity, and I believe that no other exercise with sails—that is, sail drill pure and simple—should be permitted.

I do not believe that long trips at sea are good in a system of training for the reason that you cannot hope to make a "seaman" in the short space of time allowed, and it is certainly true that the routine of any ship is subject to fewer interruptions while she is at anchor, or underway in some quiet roadstead, than during a twenty or thirty day trip at sea. A steamer working during the summer in and about Gardner's Bay, with possibly a run down to the Chesapeake now and then, seems to me likely to give better results than one spending the same time on a cruise to Europe and back.

With regard to the number of officers and petty officers necessary for duty on training ships, there can be no question as to the necessity of a sufficiently liberal allowance of both in order that efficiency may be attained, but I believe that in this connection the point to be insisted upon is the allowance of petty officers.

There is no doubt in my mind that the squad system recently inaugurated in the training service furnishes the key to the solution of the problem of how to do the greatest good to the greatest number, and with that system in operation the question of the supply of petty officers becomes of prime importance. The application of the squad system admits of a reduction in number of line officers necessary for training ships, since under that system the divisional officers act as heads of departments in a way, and, consequently, the number of recruits in a division need not depend upon the number that one officer is capable of instructing; and the whole

number of recruits to be taken on board may be based upon the number of petty officers available for duty. It goes without saying that the petty officers for training ship duty should be the best obtainable and should be, as far as possible, qualified for the duty by previous instruction at the petty officers' school.

With the squad system in operation the natural duty of the divisional officers would seem to be as heads of departments—one officer to outline a course of, and to be responsible for the instruction of all recruits in seamanship, one for gunnery, etc., all the instruction being done by the petty officers. Incidentally it may be remarked that the responsibility thrown upon petty officers by this system cannot but result in improving their own efficiency, and that such improvement is necessary seems to be admitted throughout the service.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

For convenience of reference these notes are arranged as follows:

A. Notes on ships of war and on navies, under the head of the naval power referred to.

B. Notes arranged under the following heads:

1. Ordnance and Gunnery.
2. Torpedoes.
3. Boilers.*
4. Steam Trials.
5. Steam Turbines.
6. Wireless Telegraphy.
7. Miscellaneous.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
ARMORED CRUISERS.			
Rivadavia	7,700	Genoa	Launched Oct., 1902.
Moreno	7,700	"	Launched, Feby. 9, 1903.

These two ships, which have hitherto been known as "General San Mitra" and "General Roca," are the latest specimens of the well-known Garibaldi type, sometimes spoken of as "Ansaldo cruisers." The Garibaldi I. and three others, virtually sisters, are in the Argentine Navy. The ill-fated Cristobal Colon of Spain was another, as was the Pedro d'Aragon, projected but never built. Then came five Italian ships, the Carlo Alberto and Pisani, variations of the type, and the three improved Garibaldis, Giuseppi Garibaldi, Varese, and Ferrucio. Finally come the Rivadavia and Moreno, described in Professional Notes of No. 104, and now offered for sale by virtue of an agreement between Argentina and Chili.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
A (ersatz-Loudon)	10,600	Trieste.	Building.
B (ersatz-Drache)	10,600	"	"
C	10,600	"	To be laid down 1903.
Babenburg	8,340	Pola.	Launched Oct., 1902.
ARMORED CRUISER.			
E (ersatz-Radetzky)	7,400	Pola.	Building.
RIVER MONITORS.			
Save	450	Neupesth.	Nearly ready to be launched.
Theiss	450	"	" " " " "

We learn from the *Armeeblatt* of Vienna that the two monitors and five patrol boats for the Danube flotilla provided for in the estimates of last year are making progress. The monitors, M and N, which are to displace 440 tons and have a speed of 11 knots, are being built by Herr H. Schönichen at Neupesth. They had been carried forward to the extent of 40 per cent at the end of December. They will carry two 12 cm. quick-firing guns in well-protected turrets, as well as a 12 cm. howitzer and four

machine guns. The patrol boats are to be of thirty tons, with 2000 horse-power, and two of them will be fitted with the Parsons turbine, which is thus to be tested for the first time by the Austrian navy. It is understood that the monitors will receive the names of Theiss and Save.

CHILI.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
Libertad	11,800	Barrow.	Launched Jan. 15, 1903.
Constitucion	11,800	Elswick.	Launched Jan. 15, 1903.

It is reported that these ships have been offered for sale to the United States, Great Britain and Germany, no one of whom wished to buy, and that Japan is now considering their purchase.

"The Constitucion, like her sister ship Libertad, launched on the 15th, at Barrow, is similar to the well-known Elswick type of ship, having a cut-away stern, balanced ruder, submerged torpedo tubes, etc. Ordered last February, one of the conditions of contract was that she should be completed in eighteen months, and although the cessation of hostilities between Chili and Argentina made it possible to alter this condition, the construction of the ship has been exceedingly rapid, the launch taking place about nine months after the laying of the first keel plate.

Her principal dimensions are as follows. Length between perpendiculars, 436 feet; breadth, 71 feet; draft, 24 feet 7½ inches; displacement, 11,800 tons. Her powers of offence are, it will be seen from the table given herewith, very great, and make this vessel, for her size, probably the most powerful yet built. One round fired from all these guns simultaneously would mean, it is estimated, the discharge of about 5800 lb. of projectiles, and the ship will be able in all to discharge about 13½ tons per minute. As will be seen, the secondary armament is exceptionally heavy, while the dangers of torpedo and submarine boat attack have been provided against by the large installation of very rapid-fire light guns. It is worth noticing also that as the 7.5-inch guns at the corners of the citadel are, according to their position in the ship, arranged to fire either direct ahead or astern, there are thus available at each end of the ship as bow or stern chasers two 10-inch and four 7.5-inch weapons, the former each firing four rounds per minute of 500 lb. weight each, and the latter seven rounds per minute of 200 lb. weight each. Provision is made for the stowage of a normal supply of ammunition of eighty rounds for each of the 10-inch and of 150 rounds for each of the 7.5-inch guns, whilst the supply for the smaller guns will be very large indeed.

The protection is also very efficient, all the larger guns being mounted within a citadel, extending from 250 feet to 260 feet in the central part of the ship. This citadel is formed of 7-inch K. C. broadside armor extending from well below the load water-line to the upper deck; and at the ends by bulkheads of greater thickness, angled in order to offer the greatest resistance to broadside attack. In the apex of the angles at each end is fitted on the centre line of the ship a barbette of 10-inch K. C. armor, and within this barbette the 10-inch guns are mounted in pairs. Of the 7.5-inch guns, one is placed at each of the four corners of the citadel on the upper deck, each behind a casemate with 7-inch armor front and 3-inch back, the remaining ten being placed on the main deck behind the broadside armor, separated from one another, both longitudinally and transversely, by armored bulkheads; there is thus little chance of more than one gun being rendered useless by a projectile penetrating the ship's side. The main armor belt, which, of course, forms the lower part of the citadel sides, is of K. C. armor 7 inches in thickness, and extends the full length of the ship, being tapered at the ends to 3 inches. An under-water pro-

tective deck with slopes 3 inches in thickness is fitted throughout, also special protection is afforded to the 7.5-inch guns below by the upper deck being made 1 inch thick throughout the citadel. It may also be mentioned that the protective deck is of 3-inch thickness outside the citadel and 1½-inch inside, and that the conning tower is of K. C. armor 11 inches thick.

The twin triple-expansion engines, which are being constructed by Messrs. Humphry's and Tennant, of London, are of 12,500 indicated horsepower, and are to be supplied with steam by twelve water-tube boilers of the Yarrow type; under forced draft the Constitucion is expected to attain a speed of over 19 knots. The normal coal capacity is 800 tons, but with all bunkers full this can be increased to 2200, enabling her to steam at the rate of 10 knots for 12,000 sea miles.

The Constitucion is, it may be mentioned, the seventh fast war vessel built by Messrs. Armstrong, Whitworth and Co., Limited, for Chili, and the list includes the Esmerelda—built in 1884—3000 tons, 18¼ knots; Blanco Encalada—1894—4500 tons, 22¾ knots; Ministro Zenteno—1897—3400 tons, 20¼ knots; Esmerelda II.—1898—7000 tons, 23 knots; O'Higgins—1898—8250 tons, 21½ knots; Chacabuco—1902—4500 tons, 22½ knots; besides the Capitan Thompson, torpedo-boat destroyer—1902—3500 tons, 29¾ knots, and the General Baquedano, training ship—1899—13¾ knots.

The Constitucion belongs to that size—about 12,000 tons—which most of the "marvel ships" affect. Regarded by herself, she seems almost impossibly good; but when reflection and research are brought to bear, we find, as the table herewith witnesses, that every nation nearly has assayed something equivalent at the same displacement. The British effort at this displacement, the Canopus class, we have omitted, in part because she is older slightly than the ships given, in part because national pride forbids us to include a ship that would tail the list. The most remarkable feature of the list is the variation of the indicated horsepower. Mostly it is due to lines. These can only be guessed at from the available figures, save in so far as a likeness between those of the Vittorio Emanuele and Constitucion is to be suspected. Certainly it is interesting to note that while but 12,500 indicated horsepower is needed to drive the Constitucion at 19 knots, the Suffren requires 16,200 for but 18 knots—a speed that the Russian ship, of apparently clumsier form, is to reach with only 10,600 indicated horsepower. Both these last, by the way, have on their early trials just scraped through at 18 knots. The Maine, with her 16,000, did little more than pass the 18-knot standard, which the Wittelsbach just managed with her 14,000. The four 18-knot ships, then, have been tried, and their allotted indicated horsepower has provided what was demanded in each case without appreciable excess. One sees, therefore, how great a part lines play in modern design

Let us now carry the comparison into other channels. Commuting the values of the shell fires to 12-pounder units on the system that we have used on previous occasions, the broadsides work out as follows:—(1) Constitucion, 81.4 units; (2) Wittelsbach, 75 units; (3) K. P. Tavritchesky, 72 units; (4) Maine, 71 units; (5) Vittorio Emanuele, 61 units; (6) Suffren, 59 units; which justifies the builders' contention that the Constitucion is the best gunned ship of her size afloat.

In armor protection it is difficult to arrange the ships in order of value. It is easy to note which is best in any particular spot, the trouble is to assign a ratio between these spots. Roughly one might assume—and expect to find—that protection is in inverse ratio to gun fire. In water-line protection we can safely place the ships as follows:—(1) Suffren; (2) Maine; (3) Vittorio Emanuele; (4) Wittelsbach; (5) K. P. Tavritchesky; (6) Constitucion. But, when we come to protection of the secondary armament, there is a change at once. This order, taking into consideration distance between guns, nature of the system, base protection, and so

COMPARISON OF BATTLESHIPS.

	Constitucion.	Wittelsbach.	Vittorio Emanuele.	K. P. Tavritchesky.	Maine.	Suffren.
Nationality	Chilian.	German.	Italian.	Russian.	U.S.A.	French.
Displacement	11,800	11,800	12,625	12,500	12,300	12,728
Length	436 (p.p.)	416½ (over all)	435 (p.p.)	371	388	410
Beam	71	67	73½	72½	72	70
Draft	24.7½ (mean)	28 (full)	25¾	27 (mean).	24 (mean).	27½ (full).
Main Guns	Four 10-in.	Four 9.4-in.	Two 12-in.	Four 12-in.	Four 12-in.	Four 12-in.
Secondary guns	Fourteen 7.5-in.	Eighteen 6-in.	Twelve 8-in.	Sixteen 6-in.	Sixteen 6-in.	Ten 6.4-in.
Tertiary guns	Fourteen 14-pdr. (3-in.)	Twelve 20-pdr. (3.4-in.)	Twelve 4-in.	Fourteen 3-in. (12-pdr.)	Six 14-pdr. (3-in.)	Eight 4-in.
	Four 6-pdr.	Twelve 1-pdr.	Twelve 3-pdr.	Twenty 1-pdr.	Eight 6-pdr.	Twenty 3-pdr.
	Four machine.	Twelve machine.			Twelve small.	Two 1-pdr.
Torpedo tubes (submerged)	Two.	Five.	Four.	Three.	Two.	Two
" (above water)	None.	One (armored).	None.	Two (armored).	None.	Two (armored).
Armor belt	7-in.—4-in.	9-in.—6-in.	10-in.—4-in.	9-in.—7-in.	12-in.—4-in.	12-in.—6-in.
Ratio of belt to length	Complete.	Complete.	Complete.	Three-fifths length.	Three-quarter length.	Complete.
Lower deck side	7-in.	6-in.	6-in.	6-in.	6-in.	5-in.
Deck	3-in.	3-in.	4-in.	4-in.	3-in.	3-in. flat.
Barbettes or bases of turrets	10-in.	10-in.	8-in.	10-in.	12-in.—8-in.	12-in.
Big gun turrets	8-in.	10-in.	8-in.	12-in.	12-in.	12-in.
On secondary guns	7-in.	5½-in.	6-in.	6-in.	6-in.	5-in. and 6-in.
Bases, secondary guns	7-in.	6-in.	8-in.	6-in.	6-in.	5-in.
			(3½ on eight tertiary guns).			
I.H.P	12,500	14,000	20,000	10,600	16,000	16,200
Speed	19 knots	18 knots.	22 knots.	18 knots.	18 knots.	18 knots.
Boilers	Yarrow	Half Thornycroft, half cylindrical.	Belleville.	Belleville.	Niclausse.	Niclausse.
Coal (normal), tons	800	653	1000 and oil.	1270 (coal and oil).	1000	820 and oil.
" (maximum), tons	2200	1400 (including oil).	2800 and oil.	1470 (coal and oil).	2000	1150 and oil.

forth, we incline to place as follows:—(1) Constitucion; (2) Maine; (3) Wittelsbach; (4) Vittorio Emanuele; (5) K. P. Tavritchesky; (6) Suffren; but the difference is very little.

As regards protection to big guns, it is not yet clear to us exactly on what system some of the big guns are being mounted, so a list cannot be given. But, roughly, what any one of these ships loses in the five qualities of armor, armament, speed, coal endurance, and handiness, she gains in some other. All six are excellent ships, and it is not very easy to choose between them on paper.

The point of interest is that they compare very well with much larger ships, though seeing they do so well on paper, in actual fact they should be less seaworthy or stout, but this is rather a matter of surmise than certainty.

To return to the Constitucion. Her salient feature is, of course, the battery of 7.5's instead of 6-inch. We do not believe much in the 7.5, that is to say, we had far sooner have two 6-inch than one 7.5-inch. But when a battery of them as numerous as the usual 6-inch battery is given, there can be little question of the gain gun for gun. Twenty-eight 6-inch might have been better, but in a ship of 11,800 tons it would hardly be possible to mount them without a fatal crowding. The alternative battery would have been that of the Wittelsbach or Kniaz Potemkin Tavritchesky. It is doubtful whether any of these would have been better. War may prove otherwise, but the odds are against it. The superior penetration of the 7.5 may be discounted in nine cases out of ten, so may that of the 12-inch over the 10-inch. At times the extra penetration may tell, but not often. When it comes to shell fire there is little doubt that the 7.5 shell, combined with 10-inch, will be better than the combination of 6-inch and 12-inch.—*Engineer*, January 23, 1903.

The Chilian Battleship Libertad.—The following is a description of the Chilian battleship Libertad, launched on January 15 from the naval construction works of Messrs. Vickers, Sons, and Maxim, Limited. Each of her two sets of engines is of the four-cylinder triple-expansion type, having one high-pressure cylinder, one intermediate-pressure cylinder, and two low-pressure cylinders, balanced on the Yarrow, Schlick, and Tweedy system. It is anticipated that the full power will be about 13,000 indicated horsepower. The steam pressure at the engines is 250 lbs., and at the boilers 280 lbs.

The cylinders are independent castings, supported at the front by wrought-steel columns, and at the back by cast-iron A-frames, to which the guide-frames are attached. Stephenson link motion is adopted for working the valves, which are of the piston type on the high-pressure and intermediate-pressure cylinders, and of the double-ported flat design on the low-pressure cylinders. A two-cylinder engine of the all-round type is fitted for reversing, and a similar engine is supplied for turning. The engines are designed to run the propellers inwards when going ahead, so that the starting platform is in the centre of the ship.

There are two main and two auxiliary condensers, the main condensers are separate and placed in the wings of the ship. The total cooling surface in the main condensers is about 12,500 square feet. One air pump is fitted to each of the main engines, worked by levers from the high-pressure crosshead.

The bedplate is of cast steel. The moving parts of the engine generally are of forged steel, and the bearings have rubbing surfaces of white metal. The crank and propeller shafts are of hollow steel made by Messrs. Vickers, Sons, and Maxim, Limited, the propellers have three blades of manganese bronze. The boss is of gun-metal.

The boilers are twelve in number and of the Yarrow large-tube type, arranged in four stokeholds. The greater part of the boilers, however, was manufactured at the Barrow Works. Each stokehold forms a separate

water-tight compartment, and is fitted with feed pumps, fans, ash ejectors, and ash hoists. The two funnels are 10 feet 6 inches in diameter over the casings. The height from the firegrate being 90 feet.

There is the usual complete system of auxiliary machinery, consisting of centrifugal circulating pumps, duplex fire and bilge pumps, evaporators, distillers, etc., also a workshop fitted up complete with a number of steam-driven machine tools.

The vessel, the great gun-power of which was referred to in our leading article last week, is of the following general dimensions: Length between perpendiculars, 436 feet, the length over all being 475 feet; the breadth moulded is 71 feet, and the depth 41 feet; the draft is 24 feet 6 inches, and at this the displacement will be about 11,800 tons. The hull is protected by an armored belt, armored citadel, and by a protective deck. The belt is 8 feet deep—3 feet 6 inches above and 4 feet 6 inches below the load water-line, and practically extends to the ends of the ship, being terminated at the after extremity by a transverse bulkhead of 3-inch armor. In the wake of the engines and boilers the belt is 7 inches in thickness, tapering towards the ends to 3 inches. In the central part of the ship an armored citadel rises from the belt armor to the upper deck, protecting the bases of the funnels, the lower parts of the barbettes, the ammunition tubes, etc. It is completed at the upper deck by 1-inch plating, and by 6-inch armored bulkheads at the ends butting on to the barbettes. The thickness of the citadel armor is 7 inches.

The protective deck extends throughout the length of the vessel, sloping down at the sides to the lower edge of the belt, the thickness within the citadel being 1½ inches. Outside the citadel the thickness is 3 inches.

The armor of the barbettes for the 10-inch guns is 10-inch in front and 8-inch in the rear, except where protected by the citadel armor, where it is proportionately reduced. The casemate protection of the 7.5-inch guns on the upper deck is 7 inches in front and 3 inches in the rear. The extension of the citadel armor to the upper, instead of to the main, deck dispenses with the necessity for casemates for the 7.5-inch guns on the main deck, but the same measure of isolation is secured as in the casemate system, by divisional bulkheads, placed between the guns, formed of 1-inch steel plating. The conning-tower is of 11-inch armor, the screen being 9-inch. All the thicker armor is of the best description, and is manufactured on the Krupp principle.

The vessel carries four 10-inch breech-loading guns mounted in pairs in barbettes, one pair commanding a right-ahead fire, and the remaining pair similarly commanding a right-astern fire. Ten 7.5-inch quickfiring guns are mounted within the citadel amidships on the main deck, and four in casemates on the upper deck. The foremost pair of the guns in the citadel and the foremost pair in casemates on the upper deck command a right-ahead fire, and the four corresponding aftermost guns will similarly command a right-astern fire. All the guns have a great range of broadside fire.

The auxiliary armament of the ship consists of fourteen 14-pounder quick-firing guns, two forward and two aft on the main deck, the remainder being on the upper deck broadside and on the shelter decks; two 12-pounder field guns, four 6-pounder quick-firing guns, four Maxims, and four 37-millimetre semi-automatic guns mounted in military tops. There are two submerged torpedo-tubes on the broadside forward.

The vessel is fitted as a flagship, accommodation being provided for an admiral and 700 officers and men. The electric and compressed-air installations embody the most modern improvements; the lighting installation including about 900 incandescence lamps, with masthead, bow, anchor, and other special lights, and also five specially-large searchlight projectors. The vessel is to have a speed of 19 knots and a coal capacity of about 2000 tons.

A vessel somewhat similar in design, and built also for the Chilian Navy,

was launched on Jan. 13 from the Elswick Works (Sir W. G. Armstrong, Whitworth and Co., Limited, Newcastle-on-Tyne).—*Engineering* of January 16, 1903.

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
République	14,865	Brest.	Launched Sept., 1902.
Démocratie	14,865	"	Building.
Patrie	14,865	La Seyne.	"
Justice	14,865	"	Ordered.
Vérité	14,865	Bordeaux.	"
Liberté	14,865	St. Nazaire.	"
Suffren	12,728	....	Under trial.
Henry IV	8,948	....	" "
ARMORED CRUISERS.			
Ernest Renan	13,562	Brest.	Ordered.
Jules Michelet	12,550	Lorient.	"
Jules Ferry	12,550	Cherbourg.	Building.
Victor Hugo	12,550	Lorient.	Just begun.
Léon Gambetta	12,550	Brest.	Lchd. Oct., 1901; com. 1903.
Jeanne d'Arc	11,270	....	Trials just completed.
Gloire	10,014	Lorient.	Lchd. 1900; complete 1903.
Amiral Aube	10,014	St. Nazaire.	Lchd. May, 1902; com. 1903.
Sully	10,014	La Seyne.	Lchd. June, 1902; com. 1903.
Condé	10,014	Lorient.	Lchd. March, 1902; com. 1903.
Gueydan	9,516	....	Under trial.
Dupetit Thouars	9,516	Toulon.	Lchd. July, 1901; com. 1903.
Desaix	7,700	....	Under trial.
Dupleix	7,700	....	" "
Kléber	7,700	....	" "
PROTECTED CRUISER.			
Jurien de la Gravière	5,500	....	Under trial.
TORPEDO BOAT DESTROYERS.			
Escopette	303	....	Under trial.
Flamberge	303	Rochefort.	Lchd. Oct., 1901; com. 1903.
Rapière	303	....	Under trial.
Sarbacane	303	Rochefort.	Building.
Carabine	303	"	"
Francisque	303	"	"
Sabre	303	"	"
Arquebuse	303	....	Under trial.
Arbalète	303	Havre.	Building.
Mousquet	303	....	Under trial.
Sagaie	303	....	" "
Epieu	303	Havre	Launched Jan. 1903.
Harpon	303	....	Under trial.
Fronde	303	....	" "
Javeline	303	....	" "
Bombarde	303	Havre.	Building.
Catapulte	303	"	"
Dard	303	Rouen.	"
Balliste	303	"	"
Mousqueton	303	Chalons.	Ordered.
Arc	303	"	"
Pistolet	303	Nantes.	Building.
Bélier	303	"	"
M_{22}	?	Rochefort.	"
M_{23}	?	"	"

French Naval Construction.—The resources of the French arsenals will this year be utilized to their utmost to make up for past delays and keep pace with the programme of naval construction. They will be at work upon no fewer than 150 vessels. Those to be put on the stocks will comprise an armored cruiser—the Ernest Renan—four destroyers, twenty-five torpedo boats, and nineteen submarines and submersibles. Work will be continued on six battleships, six armored cruisers, nine destroyers, seventeen torpedo boats, and thirteen submarines, and besides these it is hoped to launch two battleships, nine armored cruisers, one belted cruiser, sixteen destroyers, nine torpedo boats, and thirteen submarines. We have already published some details of the Ernest Renan, which will have three triple-expansion engines of 38,000 horsepower, and we may add that besides the two guns of 240 mm. and twelve of 164.7 mm., she will have twenty-two quick-firing guns of 47 mm. and five torpedo tubes. Her range of action will be 12,000 miles at 10 knots and 1025 miles at 23 knots. The battleships Democratie, Justice, and Vérité, of 14,870 tons displacement, are being built in private shipyards, and though officially classed as "under construction," preparations are only now being made to put them on the stocks owing to the temporary postponement of the contracts last year by the Minister of the Marine. These squadron battleships will have a length between perpendiculars of 133.8 m. and a beam of 24.25 m. Each will have three engines developing 18,000 horsepower and driving three propellers, the two side screws having a diameter of 4.85 m. The calculated speed is 18 knots. Each vessel will have forty-eight guns, including four of 305 mm. She will have two masts, one with fighting tops containing two guns of 47 mm. and the other for signals. The armor will comprise a complete belt 28 cm. in thickness. Of the six decks two will be armored. Another interesting type of vessel is the new submersible, which will have a length of 48.9 m. and a beam of 4.2 m. She will have two propellers driven by internal combustion engines, and the speed is estimated at 11 knots. Considering the number of submersibles being put on the stocks, it would seem as if they are preferred to the electric submarines, which latter are being largely replaced by torpedo boats. Experience at the manœuvres has shown that for the purpose of coast defence the torpedo boat can do as much as the submarine, and if the latter is to be efficient it must have a larger range of action and be useful for attack, wherefore the French are centering their attention upon the improvement of the submersible.—*Engineer*, February 20, 1903.

The French naval shipbuilding programme, just issued, shows that 49 vessels are to be commenced this financial year, 51 are to be continued, and 50 will be completed. The total of 150 includes 8 battleships, 16 armored cruisers, 1 protected cruiser, 29 torpedo-boat destroyers, 51 torpedo boats, and 45 submarine vessels.

The most interesting feature of the programme is the submarine boats, of which 19 are to be commenced in the Government Docks during this year, while 13 are to be continued and 13 others completed. Those to be continued embrace three different types, designed respectively by Messieurs Romazzotti, Bertin, and Mougas. The first is of 160 tons displacement, having a length of 121¾ feet, and it will be propelled by two propellers, as compared with one adopted in most of the submarine boats. These propellers will be driven by an internal combustion motor, and it is expected that the speed of the submarine will be 10½ knots. Another of the submarine boats has a displacement of 202 tons, the length being 135 feet 8 inches, and the speed in this case, it is expected, will be 11 knots. The other ship is still larger, her tonnage being 213 tons, and her length 143 feet 5 inches. She will have a single propeller, and will also, it is expected, make a speed of 10½ knots.—*United Service Gazette*, January 31, 1903.

Le Yacht says that under the programme of ships to be completed in 1906 the French Navy will have 363 first class torpedo boats, of from 85 to 90 tons displacement. These boats all have single engines, and, up to number 145, single boilers; beyond that they have two boilers each. They carry one bow tube and one pivoted tube. They have been already completed up to number 285.

It appears that the new armored cruiser Ernest Renan will differ materially from the Jules Ferry, upon whose plans she was to have been constructed. The displacement will be 13,562 tons as compared with 12,550 tons, and the speed 23 knots as compared with 21 knots. In explaining his policy before the Chamber, the Minister attached the greatest importance to the question of speed, and his views are borne out in the characteristics of the new cruisers. In addition to increasing the speed he has added to the coal capacity, and a supply of 2300 tons is to give a a range of 12,000 miles at 10 knots and 1025 miles at 23 knots. Something has been sacrificed in the matter of armament. Two 9.4-inch guns take the place of four 7.6-inch, and there will be twelve 6.4-inch as compared with sixteen. On the other hand, there will be an addition of two smaller guns. Evidently a high speed and larger coal capacity have been given great weight in the design. The length will be 515 feet 10 inches, beam 70 feet 6 inches, and draft 26 feet 10 inches. The complement will be 638. The Jules Michelet will have the same armament as the Ernest Renan, but it is announced that her other characteristics will not be changed. There are modifications also in the new battleships—ten 7.6-inch guns will take the place of the intended eighteen of 6.4-inch. On the other hand, eight 3.9-inch guns will be added.

During 1902 the following new ships have entered into active service: The battleship Jéna, the armored cruiser Montcalm, the protected cruiser Chateaurenault, with respective speeds of 18, 21, and 24 knots; the torpedo-boat destroyer Pertuisane, of about 27 knots; the seagoing torpedo boats Typhon, Boussasque, Rafale; a number of first class torpedo boats; the submersibles Sirène, Triton, Espadon and Silene; and the submarines Konigan and Farfadet. The armored cruisers Jurien de la Gravière, Gueydon, Marseillaise, Dupleix, Kléber, and Desaix have begun their speed trials; the Jeanne d'Arc will very soon finish hers; the Dupetit-Thouars, Amiral-Aube, Glorie, Condé, Sully, and Leon Gambetta are so far advanced that they will begin theirs during 1903. The battleships Suffren and Henri IV also begun their trials in 1902. Only one of the new ships of the last programme has been launched—the Republique. The reconstruction of the battleships Magenta and Devastation and the coast defence ships Indomptable, Requin, and Caiman has been finished, and that of the Marceau begun.—*Le Yacht,* January 17, 1903.

The French cruiser Jeanne d'Arc left Toulon on the morning of Friday, the 23rd of January, in order to undergo her official trials at full speed. The results were inferior to what had been anticipated. The engines developed 30,000 horsepower, the number of revolutions per minute was 137, and the speed attained was only 21.8 knots. The coal consumption was about 1 kilogramme (2.2 lb.) per horsepower per hour. The temperature in the stokehold was bearable.

The torpedo-boat destroyer Sagaïe, just built at Havre, reached Cherbourg December 20, 1902, for her acceptance trials. She is an improved Durandal. Displacement 303 tons, length 56.3 m., width 5.98 m., draft 2.85 m., estimated H. P. 6300, and speed 28 knots, as against the 26 knots of the original type; radius of action 2300 miles at 10 knots with 26 tons of coal, and 217 miles at 28 knots. Her armament is two torpedo tubes,

one 65 mm. and six 47 mm. R. F. guns; four officers and 58 men. Her propelling machinery consists of two independent triple-expansion engines and two multitubular boilers of Normand pattern.—*Le Yacht.*

The armored cruiser Gueydan went out for further sea trials on December 9. The trial was for six hours at natural draft and 14,000 H. P. The coal used per H. P. per hour was 782 grammes; the measured speed was 18.4 knots, a very satisfactory result. She is to go out again for a 24-hour trial on December 20.—*Le Yacht.*

THE FRENCH SUBMARINES.—The French Naval Department have made a point of surrounding with an air of very great mystery the construction and the trials of their various submarines; we are told that even French naval officers are not allowed to approach any of these small craft if they are not appointed for service in them for the time being. Such being the case, the very great enthusiasm shown by the public, at the Ministry of Marine, and in Parliament for this class of ship appears to us more or less singular. No one can be much the wiser now than a few years back as to the services such craft would be able to render in actual warfare; but notwithstanding this, their number has gone on increasing, their types have multiplied, and public subscriptions have been set on foot for raising funds to aid in their construction. The designs of the submarines which are being built by the French Government must necessarily be based upon the inventions of numerous private engineers, who have devoted their energy and enterprise to this particular subject, and have made known the arrangements and the mechanism of their ships. We do not believe that these have been altered in any material way by inventions made in the French arsenals.

The first submarine, of what we may term the modern type, to be built in France was the Gymnote, designed by M. Zédé. Her dimensions are:

Length	55 ft. 9 in.
Beam	5 ft. 11 in.
Draft aft when afloat	5 ft. 11 in.
Displacement	30 tons.
Engine power	55 indicated horsepower.
Speed	12 knots (?)
Complement	9 men.

The second type was the Gustave Zédé, designed by Messrs. Romazzotti and Maugas, French naval architects:

Length	160 ft. 9 in.
Beam	9 ft. 10 in.
Displacement	266 tons.
Complement	11 men.

The material forming the hull of this submarine is brass, instead of steel, as in the case of the Gymnote; she was provided, moreover, with a torpedo-launching tube.

Neither of these types, however, were satisfactory; the second one was found to be of too large dimensions, and the French Ministry of Marine decided to invite tenders for new types. The competition was closed at the end of 1897; six schemes had been sent in, M. Romazzotti and M. Maugas were awarded a gold medal, and the naval authorities decided to put in hand rapidly the Morse, on the designs of M. Romazzotti. A similar award was granted M. Laubeuf, whose design, slightly modified subsequently, is embodied in the Naval. Awards were also granted for the other designs, but these, it would appear, led to no practical results. The Morse and the Narval were launched in 1901. The former is not able to run at any great distance from her base, to which she is compelled

to return for a fresh supply of electric motive power. The Narval, on the other hand, is autonomous, in that she is fitted with a steam engine for navigation on the surface, and with an electric motor supplied by a storage battery for submarine navigation; the steam engine is used also to recharge the storage battery. Her radius of action is therefore much greater than that of the Morse. The Narval can also navigate partly submerged, her short funnel and the armored dome over the conning-tower being alone out of the water. It may be remarked here that the French Government are contemplating the construction not only of submarine boats, but also of torpedo-boats for service when only partly submerged, as stated. These are styled *submersibles*, to distinguish them from the submarine boats proper.

The French Navy contains at the present time three submarines of the Morse type, the two latest being the Français and Algérien. Their hulls are of steel, instead of brass, as in the case of the Morse. The three have the same dimensions:

Length	118 ft. 1 in.
Beam	8 ft. 10 in.
Draft aft	9 ft. 0 in.
Displacement	146 tons.
Complement	9 men.
Speed	Morse, 10 knots; the two sister-ships, 13 knots.

The Morse has a radius of action of about 150 miles on the surface, at a speed of 5½ knots, and of 174 miles at a speed of 4.9 knots. We are told that her optical tube gives satisfaction. But the time she takes in performing her evolutions, and the length of her radius of gyration, are found fault with.

Another series of four non-autonomous submarines, of the Lutin type, were put down while the three referred to above were being completed. These four boats are on M. Maugas's designs. The hulls are of steel, the French submarines being no longer built of brass. Their principal dimensions are as follows:

Length	134 ft. 6 in.
Beam	9 ft. 6 in.
Draft aft	9 ft. 6 in.
Displacement	185 tons.
Speed	12.2 knots.

This increase in the length would not, it would seem, tend to facilitate the evolutions of the craft. Motive power is insured by a storage battery, and the armament consists of four torpedo holders—a too large number, according to some French authorities.

The Narval type of boat is by far the most interesting, as it can act as a torpedo-boat, a *submersible*, and a submarine boat. It consists of an inner hull surrounded by an outer one, the latter practically similar in shape to that of ordinary torpedo boats, and the space between the two forms water-ballast tanks. Both the inner hull and the outside one are of steel. The steam engine is of 250 horsepower, built by Messrs. Brulé and Co.; it is supplied with steam from a multitubular boiler on the A. Seigle system, with five injection burners, and heated with heavy petroleum oil. When the steam engine drives the propeller, and the boat is almost completely submerged—the funnel and armored dome alone being out of the water—the speed is said to be about 11 knots; under these conditions the radius of action is 253 miles. When steaming at 8 knots the radius of action is 624 miles. When navigating on the surface, like an ordinary torpedo-boat, the speed about 12 knots. The storage battery allows radius of action under water of 25 miles at a speed of 8 knots, and of 70 miles at a speed of 5 knots. The complement is nine men, under the command of two officers. The armament consists of four

torpedo-holders on the Drzewiecki system for broadside firing. The principal dimensions of the Narval are the following:

Length	111 ft. 6 in.
Beam	12 ft. 5 in.
Draft aft	5 ft. 3 in.
Displacement	106 tons.

Immersion is produced by the action of the horizontal rudders and with the help of the water ballast in the space between the inner and the outside hulls. The introduction of water in this space takes, however, a rather long time—about twenty minutes—owing to the buoyancy of the boat when afloat, and this forms cne of the great faults found with the Narval. It is found also to be an expensive type of boat to build; the cost is about 800,000 francs (32,000*l.*). Notwithstanding this, four submarines of the same type were put down shortly after the completion of the Narval, and eight others will soon be ready for service. The Sirène is the prototype of the four boats in question; they have slightly less beam than the Narval and contain some improvements to lessen the time taken for immersion.

The French Admiralty is still feeling its way, and has not yet been able to build a final and fully satisfactory type of submarine; the submersible type is not generally approved of, seeing that eight submarines of the non-autonomous class and on new designs have been provided for in the Budget for 1901. This raises to twenty the number of these same boats, of the Lynx class, in course of construction, the principal dimensions of which are the following:

Length	77 ft. 1 in.
Beam	7 ft. 5 in.
Draft	7 ft. 11 in.
Speed	8 knots.
Complement	1 officer and 4 men.
Cost	366,000 fr. (14,640*l.*)

It would appear rather hazardous to build simultaneously twenty units of a practically new kind of boat; many experts, in fact, though they be in favor of submarines, disapprove entirely the haste shown in laying down so large a number of boats that have never been fully experimented upon.

Besides these, three other new types are also in hand. The first type is being constructed at Cherbourg on the designs of M. Romazzotti; this will cost 500,000 francs (20,000*l.*). The second type, designed by M. Maugas, is being built at Rochefort; its cost is 780,000 francs (31,200*l.*). The third type has been designed by M. Bertin, the Chief Constructor to the French Navy, and is in course of construction at Toulon; the cost will be 924,000 francs (36,960*l.*).

The Espadon, a sister-ship of the Narval, has recently completed her trials, during which she ran from Cherbourg to Havre, in very bad weather, both afloat and submerged. It is stated that at one time she remained submerged for 12 hours and 4 minutes, and was compelled to come to the surface for recharging her storage battery and renewing her supply of compressed air. The speed under water was eight knots for 350 revolutions of the propeller. The time taken for submersion was six minutes only, instead of 20 minutes as in the case of the Narval. The trials of the Triton, another boat of the same class, consisted in her submersion for two hours, off the Cherbourg breakwater; she then ran to the Hève point, recharging her accumulators the while, the steam engine running at 250 revolutions. The total run was 72 miles. The return journey to Cherbourg was effected on the surface in very bad weather; all ports were closed and the temperature inside the boat reached 55 deg. Cent. The Farfadet, of the Lutin class, remained submerged for one hour and a half; she takes six and a half minutes for complete submersion.

It will be remembered that during the last journey of the Czar to France the programme included a display at Dunkirk of three submarine boats from Cherbourg. This display did not take place, and the public were informed that, "owing to the heavy seas that were running at the time, the submarine boat manœuvres had been countermanded." This was evidently a very bad excuse to give. The real reason was that the arrival of the Czar had been delayed; this led to a modification of the programme, and the authorities forgot to inform the submarines, who kept their stations awaiting orders which never came. The three submarines in question were the Algérien, the Morse, and the Narval. At that time the latter had already made a trial trip between Cherbourg and St. Malo, and the Morse had been from Cherbourg to Havre. The Algérien, however, had not yet completed her trials. On the crossing to Dunkirk the Narval called at Fécamp and Boulogne; the Morse and Algérien called at Fécamp and Calais. On the return trip the Narval called at Calais, Dieppe, and Havre, and the two others at Boulogne, Dieppe, and Havre. As already stated, the Narval can recharge her accumulators with her own steam engine; she, however, uses some of her electric power when navigating on the surface, for working a number of her pumps, ventilators, etc., and it had been decided to recharge her accumulators at the ports of call, as was the case for the two other boats, in order to afford the men some rest. The experiment was interesting, in that it showed the facility with which the accumulators can be recharged from various points on the coast; it proved also, however, that this eventuality had not been considered fully enough in the arrangement of the batteries, and in their voltage compared with the voltage of the electric plant available at the various points of call. This meant a great loss of time, which might lead to serious consequences in actual warfare. The submarines were accompanied by convoy ships, who were to come to their assistance in case of necessity, and also to speak all passing craft in order to prevent collisions. The submarines, however, entered all the harbors without the aid of the convoys, and manœuvred satisfactorily throughout. Advantage was also taken of the journey to Dunkirk and back to ascertain whether this class of boat can readily be towed, as in the case of non-autonomous submarines of the Morse and Algérien type it would be most important to bring them as near as possible to the scene of operation without their being compelled to use any current from their accumulator supply. It was found that towage is possible in ordinary calm weather, but that in a rough sea the difficulties are similar to those met with in the towing of any other craft. As a rule, from Cherbourg to Cape Gris-Nez the sea was very rough, and at each wave the domes of the boats when navigating on the surface were covered by about 10 inches of water. The ventilators just managed to act, and it was possible to navigate without closing down all the ports. Navigation with all openings closed is most wearying for the men. Under even the best circumstances service on the submarines is a very trying one; the men are cramped up in a narrow space where they can hardly move. This may render a double number of submarines necessary in order to insure a continuous service, and may partly explain the haste with which the French Navy are building this class of boat. The Narval, though higher in the water than the Morse and the Algérien, keeps the open sea with difficulty, and would frequently have to rely on the lookout man on board the convoy to discover the enemy.

In the course of manœuvres which took place off Cherbourg in the commencement of last year, the Amiral Tréhouart steamed out of Brest to simulate an attack on Cherbourg. The sea being rough, the torpedo boats forming the mobile defence of St. Servan were not able to leave the roadstead. The Cherbourg submarines, however, had got rapidly under weigh; they took up positions off the Cape de la Hague, in the Sainte-Anne Bay and in the West Pass, and discharged their torpedoes accurately against the Amiral Tréhouart. On the following day, the Bouvines, Amiral

Tréhouart, and Cassini made a combined attack on Cherbourg. The harbor was defended by the *submersible* boats and submarines Narval, Espadon, Triton, Français, and Morse. We have not been able to ascertain the exact problem set for solution, but believe that the enemy's squadron, approaching from the east and the west, was to steam off the breakwater and bombard the Arsenal. At the right moment, the Morse and Narval started for the Cape de la Hague, the Triton and Espadon took up a position off Cape Levi, and the Français was stationed north of the breakwater. The action took place in the afternoon; the Espadon and Triton were contemplating a combined attack on the Amiral Tréhouart, when an incident occurred which placed one of the submarines in a difficult position. The Triton was going to launch a torpedo against the battleship, when a fishing-smack crossed her field of fire. She came on the surface, was discovered, and shelled by the battleship. On the other hand, however, the Espadon torpedoed the Amiral Tréhouart. The Narval failed to be effective in her attempts; but the Morse would have wrecked the Cassini had the latter not escaped, thanks to her speed; in escaping from the Morse, however, she ran near the Français and was torpedoed. In July last Vice-Admiral Fournier ordered manœuvres to be carried out between Cherbourg and Brest. The submarines got under weigh at a moment's notice, and journeyed to Brest, convoyed by torpedo boat No. 60, which burns liquid fuel. This torpedo boat would have been but of little help in the case of an accident to the submarines. The Narval remained at Cherbourg to make good a defect in her piping. The Espadon, Triton, Sirène, and Silure alone took part in the manœuvres. They left at a late hour in order to take advantage of the current which runs from the Cape de la Hague to beyond Guernsey. The weather became rough in the course of the night; the submarines were swept by heavy seas, and were compelled to take shelter in the small harbor of Perros Guirec, to rest the men, who were worn out with fatigue. The next day they endeavored to leave, but were compelled to return in front of a great swell. They resumed their journey on the day following, and after calling at Bertheaume Bay, they reached Lauberlach Bay, at the end of the Brest roadstead, without being seen. It should be remarked, however, that no look-out had been kept to ascertain their arrival. Various experiments were carried out in the Brest roadstead. Torpedo boat 60 endeavored to fire on the periscope of one of the submarines, but before a quick-firing gun could be aimed at it, it had disappeared, and was seen some distance away, on the other side of the torpedo-boat. On the return journey the flotilla covered in one day the 200 miles which separates Brest from Cherbourg, the weather being particularly fine. In September, 1902, manœuvres were carried out off Cherbourg, in which six submarines and various coast-defence ships took part. On this occasion the Morse succeeded in coming to the surface unobserved at about 600 yards distance from the Valmy, although a sharp look-out was kept on board the latter ship. The battleships altered their tactics and shifted their helm constantly, thus rendering the task much more difficult for the submarines. The latter kept generally at a depth of 20 feet, and reconnoitred by means of their periscope, without much success. The Français located a battleship by the eddy of the latter's propeller, and torpedoed her at a venture from the depth of 20 feet, and managed to strike her. The submarine then plunged to a depth of 56 feet, passed under the battleship, and torpedoed her on the other side. She then came to the surface. Fortunately, it so happened that the battleship in question belonged to the enemy's fleet; it might have been otherwise! During the following manœuvres the coast-defence ships were to run the blockade of Cherbourg harbor, the entrance being kept by submarines. The latter were therefore on the defensive, a more favorable position, but one that may not occur frequently, and could not last any length of time. However, the Espadon twice torpedoed the Valmy and Jemmapes; the Triton also torpedoed the Jem-

mapes, and the Algérien torpedoed the Bouvines. These manœuvres were effected in a heavy sea and rainy weather, which rendered the submarines still more invisible. They were submerged the whole time, and this laid a very heavy strain on the men. An amusing trick practiced by the crew of submarine boats to deceive the battleships is to weight a number of bottles and let them float, the neck only appearing out of the water; those have exactly the appearance of the end of a periscope when it protrudes at the surface for the taking of observations.

Later manœuvres have confirmed the results obtained in those we have briefly described. These results have shown that the French submarines are likely to be of service in actual warfare, although they may be defective in some of their details. A final type has not yet been decided upon, but nevertheless the arsenals are in full work upon this kind of craft, and this haste is very generally complained of in France. Previous to the naval programme of 1900, mentioned in one of our preceding issues (see *Engineering*, vol. lxxiv., page 713), there were twelve submarines in the French Navy. The Budget for 1901 provided for eight more, but this number was carried to twenty. No further submarines of a new type were put in hand in 1902, but three improved (or modified) types were designed. In the course of the present year twenty-six are to be built, and a greater number still in 1904. We are told that in 1902 the increase in outlay for *personnel* only, due to the submarines, reached a total of 850,000 francs (34,000*l.*). Special berths are to be provided for submarines at various points of call along the coast—probably at Dunkirk, Boulogne, Cherbourg, Brest, Lorient, Oran, Algiers, Biserta, Corsica, Villefranche, Port-Vendres—with electric generating stations for recharging the accumulators.

A proof that the French Admiralty is still far from having decided upon a final design is afforded by the constant alterations that are made in many details while the boats are in course of construction, and by the different types which are laid down before the previous ones have been experimented upon. Further, some naval experts advocate submarines, or, rather, *submersible* boats, of 300 tons—the twenty now in course of completion are of 68 tons only—owing to the fact that the smaller ones are absolutely uninhabitable. Others advocate submarines of 10 tons only, to be transported on board battleships to the scene of an action. These would be provided with accumulators to work 14-horsepower motors, and their cost is estimated at 65,000 francs (2600*l.*), not counting the accumulators.

The present Minister of Marine has delayed the construction of several new types until those completed and in course of completion have shown their value or their defects; and his decision is generally approved of.—*Engineering*.

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
Wittelsbach	11,900	Wilhelmshavn.	Under trial.
Wettin	11,900	Dantzic.	" "
Zähringen	11,900	Kiel.	" "
Mecklenburg	11,900	Stettin.	Lchd. Nov., 1901; compl. 1903.
Schwaben	11,900	Wilhelmshavn.	Lchd. Aug. 1901; compl. 1903.
Braunschweig	13,200	Kiel.	Lchd.; complete in 1904.
J.....................	13,200	Dantzic.	Building; " " "
K	13,200	Stettin.	" To be compl. 1905.
L......................	13,200	Kiel.	" " " " "
M	13,200	Wilhelmshavn.	Ordered.
N	13,200	....	Projected.
ARMORED CRUISERS.			
Prinz Heinrich........	8,868	Kiel.	Under trial.
Prinz Adalbert	9,050	"	" "

VESSELS BUILDING.—CONTINUED.

Name.	Displacement.	Where Building.	Remarks.
Prinz Friedrich Karl..	9,050	Hamburg.	Launched June, 1902.
D (Ersatz Kaiser)......	9,050	Kiel.	Building. Complete 1905.
E......................	9,050	Hamburg.	" " "
F......................	9,050	Kiel.	" " "
PROTECTED CRUISERS.			
Frauenlob	2,715	Bremen.	Lchd. Mar., 1902; compl. 1903.
Arcona................	2,715	"	Lchd. Apr., 1902; compl. 1903.
Undine	2,715	Kiel.	Lchd. Dec., 1902; compl. 1903.
K	2,715	Stettin.	Building; complete 1904.
L	2,715	Bremen.	" " "
M (Ersatz Zieten)	2,715	Dantzic.	" " "
GUNBOATS.			
Panther	900	"	Launched April, 1901.
B	900	Stettin.	Building.
TORPEDO BOAT DESTROYERS.			
108 to 113 (6 boats).....	350	Kiel.	All lchd. (4 completed trials).
114 to 119 (6 boats).....	350	Elbing.	Building (2 launched).

The German naval budget for the present year provides for the laying down of two battleships, M and N, a large armored cruiser, Ersatz Deutschland, two small cruisers, and a torpedo division. The period for the termination of the vessels in hand is indicated. K and L, which are under construction at the Vulcan and Germania Yards, should be ready in the summer of 1905. The date for the armored cruiser Ersatz Kaiser, which is in hand at the Imperial Yard, Kiel, is the autumn of the same year. The three small cruisers, Ersatz Zieten, K, and L, are to be completed in the spring of 1904. They are of the Gazelle type enlarged, and displace 3000 tons. *Ueberall*, in an article upon the German Navy in 1902, which indicates the progress made, points out, in relation to the length of time in which battleships are in hand, that the period in the case of the Kaiser Karl der Grosse was 40.5 months, of the Wittelsbach the same period, of the Zähringen 35 months, and of the Wettin 35.7 months. The increase of the fleet is making necessary an addition to the number of officers, and this year there will be 115, including one vice-admiral, five captains, eleven commanders, twenty-five lieutenants, thirty-two sub-lieutenants, forty-one midshipmen, thirty-two probationary officers, and thirty cadets.—*Army and Navy Gazette.*

During 1902 the battleship H (Braunschweig), the armored cruiser Prinz Friedrich Karl, the three protected cruisers Frauenlob, Arcona, and Undine, and 7 torpedo-boat destroyers were launched; the battleships Kaiser Barbarossa and Kaiser Karl der Grosse, and the fourth class cruisers Amazone, Ariadne, Medusa, and Thetis entered active service; and ten torpedo-boat destroyers completed their trials.

The New German Battleship H.—The two latest German battleships, H and J, now in the launching state, are what the French call "ameliorations" of the Wittelsbach type. Ameliorations is a much happier term than "modifications" or "improvements on," for it expresses the truth far better than our usual stock phrases.

We have recently described the Zähringen, of the Wittelsbach type, at such length that we do not propose here to cloud the main issue by dwelling on details that apply equally to both ships. H, in the course of being "ameliorated," has increased in tonnage, and all the interest centres on the application of this 1000 tons of increase. That is the matter of importance.

The main ameliorations are as follows:

(1) Substitution of 11-inch for 9.4-inch big guns.

(2) Substitution of fourteen 6.7-inch for eighteen 6-inch.

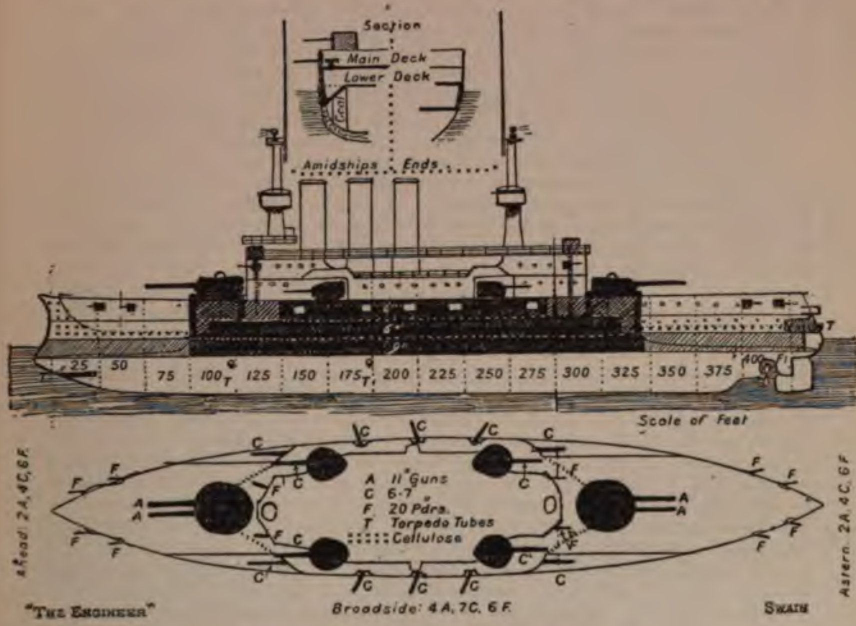
(3) Abolition of the rather amateurish idea of placing secondary guns under the blast of the big guns.

(4) Extension of the main deck battery wall into a complete redoubt from barbette to barbette.

(5) Sacrifice to the enormous end-on fire characteristic of German ships.

(6) Much greater distribution of the 20-pounder guns.

Now, before proceeding to discuss these, we may say at once that one and all mark the fact that a practical man is controlling ship design in Germany. He has taken the Wittelsbach design, and while retaining the



NEW GERMAN BATTLESHIPS.—Section and Plan.

main features, wiped out most of the objectionable points, or most of those that it is the fashion to consider objectionable. And every criticism that we propose to offer should be read in the light of the fact that he was presumably compelled to keep down the displacement as much as possible. The configuration of the German coast demands ships of moderate dimensions and relatively light draft. Other considerations seem to demand as much armament on 13,000 tons as is usually secured on 15,000 tons; and this, of course, cannot be obtained without sacrifices. On paper, it is coal that has gone; in actual fact, we suspect that economies in connection with scantlings, and so forth, are part of the price. Some of the thousand extra tons in H perhaps goes in this direction. The Kaiser class are certainly not distinguished for strength under water, despite all the pretty stories as to how well two of them, the Friedrich III and Wilhelm II, stood running over the rocks at full speed. There is no clear evidence as to the exact submergence of the rocks over which these ships passed at the time of the disaster; the only solid fact is that in circumstances appar-

ently akin to those in which ships scrape off some of the outer skin, these ships sustained serious damage to the inner skin. A scientific explanation about the oil fuel in the double bottoms transmitting the force of the blow was forthcoming, but most ships use their double bottoms to carry things that might equally well transmit the force of a blow. Hence the incident is usually accepted as evidence that the sacrifice to attain 15,000 tons on 12,000 or less affected the under-water hulls. It stands to reason that to get abnormal power out of a moderate weight of ship every possible economy will have had to be effected.

Let us now resume. With regard to the first amelioration, we doubt whether the substitution of 11-inch for 9.4-inch guns is any very great gain, save in so far as the fact that the 9.4 Krupp is not the most ideal piece of that or similar calibre in existence. Outside the proving ground a forty-calibre 11-inch is not going to equal a forty-calibre 12-inch. It is less inferior than a 9.4, but that seems the total of the advantage. Its shell is still inferior in bursting power, and the 9.4 is quite equal to all medium armor according to its assigned power of penetration. Against thick armor the 11-inch, 12-inch, and 9.4-inch are likely to fail alike, unless the capped shell turns out to have a real practical value. If so, then a 9.4 is enough for all present needs, or any immediate future needs.

The same argument applies in great measure to the 6.7. We much doubt whether its slightly increased penetration is of real value, despite its muzzle energy of over 9000 foot-tons. It may be remarked, however, that —unless the secondary turret guns had been in pairs—there is not room for more than fourteen secondary guns, and fourteen 6.7 may well be assumed better than the same number of lighter pieces.

Under the third head we have noted the avoidance of the error of placing secondary guns under the big guns forward. It is morally certain that guns under big guns are a grave mistake. Even if the blast inflicts no injury on the crews of these lower guns, it must greatly incommode aim. Someone with a genius for excuses once observed that such guns were valuable in so far as men at them would not be disturbed by shell fire outside, for it would merely reproduce the blast to which they were used; but we hardly think this theory was put forward seriously.

Incidentally it may be noted that the abolition in H of the four-gun battery that is forward in the Wittelsbach, has also led to the reduction of the height of the fore turret by a deck. It is now just where we, the Americans, and the Japanese, carry our big guns. There will probably be a gain in seaworthiness in this connection.

The fourth amelioration, the extension of the walls of the main-deck battery, till they reach the barbette walls is a distinct advantage, for it affords protection beneath the conning-towers. Whether a battery is—save on paper—better than the casemate system, is a vexed question. Personally, we fancy that the continuous battery of medium armor gives too much for the big guns of the enemy to act on; but, of course, there are two sides to the question. Ultimately these batteries will become thicker, and perhaps proof against big-gun fire, and as likely as not carry big guns inside them. There is no reason to suppose that both big and medium guns are essential to a warship, but as no one can tell which kind is the essential piece, both have to be carried. In the next naval war we shall doubtless ascertain which is the winning piece against ships almost covered with armor.

The sacrifice of end-on fire is extremely characteristic of H. The Wittelsbach brings eight 6-inch to bear right ahead. H has but half that number of her auxiliary armament bearing on the bow. The change is of an extremely important nature, and portends either that the Germans have discovered that it is difficult to preserve intact the ship that fires right ahead, or else it means that Germany is falling in line with the British idea that the broadside fire is the only fire of importance. It would be interesting to know which opinion led to the change. We surmise the first.

Date of design *circa*..........	1900	1899	1897	1900	1896	1899	1897
Name.......	H and J.	Wittelsbach.	Suffren	V. Emanuele	Canopus	Borodino	Tavritchesky
Nation........................	German	German	French	Italian	British	Russian	Russian
Displacement.	13,000	12,000	12,728	12,625	12,950	13,566	12,500
Length..........	400 (p. p.)	416½ (over all)	410	435	390 (p. p.)	397	371
Beam.........................	73	67	70	73½	74	76	72½
Draft (mean).................	25	25 (mean)	27½ (full)	25¼ (full)	26½ (full)	26	27
Heavy guns..............	Four 11-in.	Four 9.4-in.	Four 12-in.	Two 12-in.	Four 12-in.	Four 12.4-in.	Four 12-in.
Medium.......................	Fourteen 6.7-in.	Eighteen 6-in.	Ten 6.4-in.	Twelve 8-in.	Twelve 6-in.	Twelve 6-in.	Sixteen 6-in.
Light.........................	Twelve 20-pdrs. Twelve 1-pdrs.	Twelve 20-pdrs. Twelve 1-pdrs.	Eight 4-in. Twenty 3-pdrs. Two 9-pdrs. Two 1-pdrs.	Twelve 4-in. Twelve 3-pdrs.	Ten 12-pdrs. Six 3-pdrs. Two maxims.	Twenty 12-pdrs. Eight 1-pdrs.	Fourt'n 12-pdrs. Twenty 1-pdrs.
Submerged tubes............	5	5	2	4	4	2	3
Above water tubes...........	1 (armored)	1 (armored)	2 (armored)	*None*	*None*	4 (armored)	2 (armored)
Armor—Belt	9-in.—6-in.	9-in.—6-in.	12-in.—6-in.	10-in.—4-in.	6-in. (2in. and 1½-in. ends)	9-in.—4-in.	9-in.
Deck........................	3-in.	3-in.	3in.	4-in.	2½-in.	4-in. also a 2-in.	4-in.
Bulkheads..................	(Complete belt)	(Complete belt)	(Complete belt)	(Complete belt)	12-in.	(Complete belt)	9-in.—7-in.
Lower deck side............	6-in. (redoubt)	6-in. (redoubt)	5-in. (redoubt)	8-in. (redoubt)	6-in. (redoubt)	6-in.—2½-in.	6-in. (redoubt)
On big guns................	10-in.	10-in.	12-in.	8-in.	8-in.	11-in.	12-in.
Big gun bases...............	10-in.	10-in.	12-in.	8-in.	12-in.	10-in.	10-in.
On secondary guns.........	6-in.	6-in.	6-in. and 5-in.	6-in. (twin turrets)	6-in.	6-in. (twin turrets)	5-in.
Bases " "	6-in.	6-in.	5-in. and 6-in.	8-in.	6-in.	5-in.	6-in.
Conning tower..............	10-in.	10-in.	12-in.	10-in.	12-in. (forward)	11-in. (forward)	10-in. (two)
Proportionate length of belt	Complete	Complete	Complete	Complete	About ½ length	Complete	About ½ length
Width of main belt.........	7-ft.	7-ft.	8-ft.	Narrow	7-ft. water-line portion	Not known	7½-ft.
Weight of armor............	4200 tons	3900 tons	*About* 3500 (?)	Not known	1740 tons	*About* 4000 tons	*About* 4000 tons
Indicated horse-power.......	16,000	15,000	16,200	20,000	13,500	16,300	10,600
Maximum speed.....	18 knots	18 knots	18 knots	22 kts. (or more)	18·25 knots	18 knots	18 knots
Normal coal (tons)............	800 (and oil)	653 (and oil)	820 (and oil)	1000 (and oil)	1000	? (and oil)	670 (and 600 oil)
Maximum capacity (tons)....	1650 (also oil)	1000 (200 tons of it oil)	1150	2800	2300	1250	870
Boilers	⅔ Thornycroft ⅓ Cylindrical	6 Thornycroft 6 Cylindrical	Niclausse	Not decided Cylindrical (?)	Belleville	Belleville	24 Belleville

A distribution of the [illegible]-pounders not very dissimilar to that common in our ships will be observed. Hitherto the German practice has been to concentrate such guns in the middle of the ship in three groups, one by each mast and one amidships. The grouping is now four-fold: the major groups of double pairs at bow and stern, the minor ones of single pairs at the mast bases. This seems a decided advance, as it reduces interference to a minimum.

Like the Wittelsbach, H has a cellular belt over the main deck, running upwards at the bow. It is probably of no utility. H is building at Krupp's Germania yard, Kiel, J at Schichau's Danzig yard.

General details of the ship in comparison with the Wittelsbach and other vessels of about the same size will be found in the table appended. The enormous weight of armor, 4200 tons, is noticeable. It is not unique, our Trafalgar of about the same displacement carries as much, and the French Formidable, an old ship of less size, also has little if any less in weight. But it contrasts strangely with the 1700 tons odd in our Canopus class. As the Canopus is of considerably less indicated horsepower, we need not look to the machinery to account for much of the 2460 tons to be accounted for. As she carries an inferior and lighter armament, it is equally futile to look there. Extra coal will account for 200 tons, but that still leaves 2260 tons. Well over 2000 tons is a good deal, but there is no solution to the mystery. One ship must have a deal of superfluous strength, or the other lack strength to an alarming degree, even if we strike an imaginary mean. The puzzle is an interesting instance of how ships contain many qualities that cannot be indicated on paper. For ourselves, the only easy hypothesis is that both ships represent errors, but that does not take us far. The Canopus, we know, carries superfluous stores, but she is certainly not crammed with over 2000 tons of them. What, then, swallows the balance?—*Engineer*, December 17, 1902.

The fourth-class cruisers of the Frauenlob class, of which the third, the Undine, was launched from the Hawaldt yard at Kiel on December 11 last, have a length of 109 m., a beam of 12.3 m., and a mean displacement of 2715 tons. They have complete armored decks from 37 mm. to 50 mm. in thickness and carry 600 tons of coal, which gives a radius of 6000 miles at 11 to 12 knots speed. Their boilers are water tubular, of Schultz pattern; he horsepower is 6000 at natural and 8000 with forced draft; and the maximum speed is 21 knots. Their armament is ten 105 mm. with shields, fourteen 37 mm., and eight mitrailleuses, together with two under-water torpedo tubes Their crew consists of 259 men.—*The Yacht.*

The battleship Wittelsbach, of 11,900 tons, has had steam trials with these results: At natural draft, 10,000 horsepower, 95 revolutions, 16 knots; at forced draft, 14,483 horsepower, 104 revolutions, 18 knots. Her sister ship, the Wettin, made 16.3 knots with 10,300 horsepower and 18 knots with 14,500 horsepower.—*The Yacht.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
A	18,000	To be laid down this year.	
B	18,000	" " "	
C	18,000	" " "	
Hindostan	16,350	Clydebank.	Building.
New Zealand	16,350	Portsmouth.	"
Commonwealth	16,350	Glasgow.	"
Dominion	16,350	London.	"

VESSELS BUILDING.—CONTINUED.

Name.	Displacement.	Where Building.	Remarks.
King Edward VII	16,350	Devonport.	Building. Will be lchd. July.
Queen	15,000	"	Launched March, 1902.
Prince of Wales	15,000	Chatham.	" May, 1902.
ARMORED CRUISERS.			
Duke of Edinburg	13,500	Pembroke.	Building.
Black Prince	13,500	Blackwall.	"
Duke of Connaught	13,500	Elswick.	"
Natal	?	....	....
Newfoundland	?	....	....
Hampshire	10,700	Elswick.	Building.
Devonshire	10,700	Chatham.	"
Roxbury	10,700	Glasgow.	"
Antrim	10,700	Greenock.	"
Argyll	10,700	Clydebank.	"
Carnarvon	10,700	Glasgow.	"
Essex	9,800	Pembroke.	Launched.
Kent	9,800	Portsmouth.	Under trial.
Monmouth	9,800	Govan { London & Glasgow Co.	"
Bedford	9,800	" (Fairfield).	Trials just finished.
Cornwall	9,800	Pembroke.	Launched Oct., 1902.
Suffolk	9,800	Portsmouth.	" Jan., 1903.
Berwick	9,800	Glasgow (Beardsmore).	Launched.
Cumberland	9,800	Govan { London & Glasgow.	Launched Dec., 1902
Lancaster	9,800	Elswick.	"
Donegal	9,800	Govan (Fairfield).	"
PROTECTED CRUISERS.			
Challenger	5,880	Chatham	Building.
Encounter	5,880	Devonport.	"
Topaze	3,000	Birkenhead (Laird).	"
Amethyst	3,000	Elswick (Armstrong).	" (To have Parson's turbines.)
Diamond	3,000	Birkenhead (Laird).	Ordered.
Sapphire	3,000	Yarrow (Palmer).	"
GUNBOATS.			
Cadmus	1,096	Sheerness.	Building.
Clio	1,096	"	"
SCOUTS.			
Adventure	2,800	Birkenhead.	Building.
Forward	2,800	London.	"
Pathfinder	2,800	Elswick.	"
Sentinel	2,800	Glasgow.	"
Nichberth	2,800	London (Vickers).	?
Nora	2,800	Glasgow (Fairfield).	?
Fastuet	2,800	Elswick.	?
Eddystone	2,800	Birkenhead.	?
TORPEDO BOAT DESTROYERS.			
Erne	550	Jarrow (Palmer).	Launched Jan. 14, 1903.
Exe	550	" "	Building.
Ettrick	550	" "	"
Cherwell	550	" "	"
Dee	550	" "	"
Derwent	550	Newcastle-on-Tyne.	"
Eden	550	"	" (To have Parson's turbines.)
Waverny	550	"	"
Velox	550	"	Launched. (To have Parson's turbines.)

VESSELS BUILDING.—CONTINUED.

Name.	Displacement.	Where Building.	Remarks.
Foyle	550	Birkenhead.	Launched Feb. 25.
Itchen	550	"	Building.
Arun	550	"	"
Blackwater	550	"	"
Ribble	550	London (Yarrow).	"
Teviot	550	" "	"
Usk	550	" "	"
Welland	550	" "	"
Kennet	550	Chiswick. "	"
Jed	550	" "	"

THE WARSHIP TRIALS OF 1902.—During the past year there were not quite so many steam trials as in two or three former years, but that was entirely due to the fact that fewer torpedo-boat destroyers had been completed, or rather that the fleet of 30-knot boats originally ordered had all passed through their speed tests most successfully, and the ships of the new type now building were not in a stage for trial. The experience with the 30-knot boats, as is now generally known, resulted in a careful consideration of the design and in modifications, so that the ten vessels included in a programme of 1901-2 were delayed, and were only given out in April last, the nine vessels included in the current financial year following soon afterwards. Those nineteen boats are to be considerably larger than the 30-knot vessels, and while the contract speed is only to be 25½ knots, they will not only carry a much larger quantity of coal to ensure a wider radius of action, but will at the same time be able to go to sea in rough weather, and maintain under all ordinary service conditions the same speed as the 30-knot boats, except, perhaps, the ordinary smooth water measured mile run. The new craft will thus be much more satisfactory and reliable than the old vessels. Only two torpedo-boat destroyers were passed through their trials last year, as compared with twelve in 1901, and of the two one was completed by Messrs. John Brown & Co., Clydebank, and the other by Messrs. Thornycroft, of London. The Clydebank boat, in its full speed trial, developed the very high power of 8903 I. H. P. continuously for three hours, and this, it may be said at once, is the highest power ever got in such a small craft. On the coal consumption trials of the same duration, the power averaged 8792 I. H. P., giving a speed of 30.89 knots, so that this vessel is the third fastest in the British navy. The Albatross got 31½ knots, the Express 31 knots, and the Arab realized 30.89 knots, which, for vessels with reciprocating engines, is eminently satisfactory, but there is every probability that the Velox, which was fitted with Parson's turbine for steaming ahead and with auxiliary triple-expansion engines for driving astern, will exceed even the best of those results, when she comes to be officially tried very shortly. She has been built by Messrs. Hawthorn, Leslie & Co., of Newcastle, who give the H. P. of the turbine engines as 8000 I. H. P. The second vessel on last year's list, the Success, by Messrs. Thornycroft, developed 6600 I. H. P., and at full speed got 30.22 knots, but the coal consumption worked out high at 2.62 lb. per H. P. per hour, while in the case of the Clydebank boat it was 2.455 lb. per I. H. P. per hour.

Of the larger vessels passed through their trials there were sixteen, as compared with fourteen the previous year, and these included six battleships, seven first-class cruisers, and three sloops. Of the battleships, four were of the Duncan class, designed to steam at 19 knots, while two were of the Formidable class to steam 18 knots. The 19-knot ships were the Duncan, built and engined by the Thames Co.; the Russell, from Palmer's Works on the Tyne; the Exmouth, from Laird's, of Birkenhead; and the Montagu, from Devonport Dockyard. All of these ships are fitted with

Belleville boilers, and in order to get the high speed the displacement was reduced to 14,000 tons, largely by the fitting of a 7-inch armored broadside, instead of 9 inches, as in the other ships, while an engine of the cruiser type was adopted so as to get the most power possible for a given weight. The vessels went through the usual programme of 30 hours' trial at 1-5th power to determine the coal consumption, a second test of the same duration at three-fourths power and an 8-hours full power run. The power and coal consumption in each of these runs are given in the following table:

	1-5th I. H. P.		3-4ths I. H. P.		Full power.	
	I. H. P.	lb.	I. H. P.	lb.	I. H. P.	lb.
Exmouth	3667	2.18	13,774	1.95	18,285	2.11
Duncan	3755	2.05	13,717	1.90	18,222	1.95
Russell	3767	2.4	13,685	2.14	18,199	2.10
Montagu	3676	2.21	13,652	1.78	......	....

The most interesting ships tried during the year were the four cruisers of the Good Hope class. These four vessels proved the fastest in the navy, the King Alfred topping the list at the full power trial by steaming 23½ knots over the measured deep sea course. The Leviathan made 23¼ knots, while the Good Hope and Drake gave a speed of 23.05 knots on their full power runs. Since those contract trials were completed certain experiments have been made with different propellers, and the result, got with the Drake, being an increase of one knot in speed. Similar propellers have been ordered from the builders for all four ships, so that all may be reckoned as of 24 knots speed, while for three-fourths the engine power, which can be realized as long as the coal lasts, the speed varies between 21¾ and 22 knots with the old propeller, and will probably be 22¾ knots with the new screws of increased blade area. At one-fifth only, the very satisfactory speed of 15½ knots was averaged by these ships with the old propellers, so that 10 knots will be got for a very low power indeed, and as a consequence their immense coal-carrying capacity will enable them to steam at ordinary cruising speed for exceptionally long distances. We give in table form the power and coal consumption results for the four ships at their various trials:

	1-5th I. H. P.		3-4ths I. H. P.		Full power.	
	I. H. P.	lb.	I. H. P.	lb.	I. H. P.	lb.
King Alfred	6419	1.75	22,616	1.82	30,950	1.81
Leviathan	6389	1.75	22,927	1.74	31,208	1.94
Good Hope	6074	1.86	22,761	1.83	31,119	1.91
Drake	6301	1.72	23,004	1.79	30,864	1.82

These results, as far as coal consumption is concerned, are remarkably uniform, and when it is remembered that trial crews are more or less of a scratch character, made up from stokers in the depot, with little or no experience of the special conditions of water-tube boilers, they must be pronounced as satisfactory. The other armored cruisers on the list are the Bedford, built by the Fairfield Company, and the Kent, constructed at Portsmouth; the Monmouth, by the London and Glasgow Company; and the Essex, which, built at Pembroke, has machinery constructed at the Clydebank Works, will both go on their trials very soon. The Bedford easily realized the power required at the various speeds, the one-fifth total being 4522 I. H. P., with a coal consumption of 1.91 lb., with a speed of 15 knots; the 30 hours' run at three-fourths power resulted in a mean I. H. P. of 16,000 I. H. P., a coal consumption of 1.97 lb., and a speed of 21¼ knots, while at full power the total indicated horsepower was 22,457, with a coal consumption of 2.12 lb. Different propellers are being tried in the subsequent ships of the class, and experience of past changes would suggest the probability of increased speed. The Spartiate, a protective deck

cruiser of the same class as the Ariadne and Argonaut, built some time ago on the Clyde, completed her trails, which were protracted over a very long period owing to difficulties with machinery and with the contractors. —*United Service Gazette.*

The armored cruiser Suffolk was launched at Portsmouth Dockyard on January 15. She is the last of the County class of cruisers, of which there are ten, to take to the water, and has been an unusually long time reaching the present stage, for she was laid down at the end of March, 1901. Her principal dimensions are as follows: Length between perpendiculars, 440 ft.; length over all (about), 463½ ft.; breadth, 66 ft.; displacement, 9800 tons; mean draft, 24½ ft. She will be propelled by twin-screws, each driven by an independent set of vertical triple-expansion engines, to one high, one intermediate, and two low-pressure cylinders, of the collective power of 11,000 horses, giving an aggregate indicated horsepower of 22,000. Steam will be supplied by 34 separate boilers of the Niclausse type. The engines and boilers are being built by Messrs. Humphreys, Tennant & Co., of Deptford. The side armor is four inches thick, and about 11 ft. deep amidships, extending in varying thicknesses right forward to the bows and finishing well abaft the engine-room at a cross-armor bulkhead. Her armament will consist of fourteen 6-inch guns, eight 12-pounder quick-firing guns, three 3-pounders, two Maxims, and two 12-pounder 8-cwt. guns for boat and field purposes. Two submerged tubes will be fitted forward, and nine 18-inch and four 14-inch torpedoes will be carried. Lady Stradbroke had been nominated by the Marquess of Bristol, Lord Lieutenant of the County of Suffolk, to perform the naming ceremony, and the launch was effected very successfully.

Messrs. Palmer & Co. launched, at Jarrow, on January 14, the torpedo-destroyer Erne, the first of five similar vessels which the Admiralty have ordered from them. The construction of the vessel establishes a record for the company, as she has been launched within seven months of the contract being given. She is 225 ft. long, and will steam 25½ knots.—*United Service Gazette.*

The armored cruiser Kent has returned to Portsmouth on the completion of her series of contract steam trials, and, as in the case of her sister ship, the Bedford, she has been unable to realize her required speed of 23 knots per hour. As the result of her eight hours' run at full power, the Kent developed a total horsepower of 22,249, which is 249 above what was contracted for, but her speed was only 21.7 knots. The coal consumption worked out at 1.89 lb. per unit of horsepower. It is considered that the cause of full speed not being realized was due to the shape of the propellers. Accordingly it is intended to provide the vessel with propellers of a different pattern, after which she will have some more steam trials.—*United Service Gazette*, Dec. 27, 1902.

It will be seen that the vessels launched for the navy this year include two battleships, the Queen and the Prince of Wales, of 15,000 tons and 15,000 indicated horsepower, which were fully described and compared with our latest battleships of the King Edward VII class on page 318 of our seventy-third volume. Of the new type of battleship, five have been laid down during the year—one each at Devonport, Portsmouth, Barrow, Fairfield, and Clydebank, the names given being the King Edward VII, New Zealand, Dominion, Commonwealth, and Hindostan. They are of 16,350 tons, 18,000 horsepower, and have very powerful armament and armored protection. Five of the other ships completed during the year are of the County class, of which four were launched last year, and one—the Suffolk—still remains to be floated. Many structural details of these vessels are given in our notice of the launch

of the Cumberland this week. Since these vessels were designed modifications have been made, and the six Devonshires laid down during this year—one each at Chatham, Clydebank, Fairfield, Beardmore's, London and Glasgow Company's works, and Elswick, differ in several respects. Two 7.5-inch guns are substituted for four of the 6-inch quick-firers; 6-inch armor takes the place of the 4-inch belt, and a combination of one-fifth cylindrical and four-fifths water-tube boilers of various types is adopted, instead of a complete installation of Belleville boilers in the earlier ships.—*Engineering*, Dec. 19, 1902.

Of the two first-class armored cruisers included in the programme for the current financial year, one, to be named the Duke of Edinburgh, is to be laid down in Pembroke Dockyard, and will be engined by Messrs. Hawthorn, Leslie & Co., and the other, to be christened the Black Prince, is to be built by the Thames Ironworks Company, at Blackwall. In both these ships, the first designed by the new Director of Naval Construction, Mr. Philip Watts, there is an important departure from the arrangement adopted in our armored cruisers of recent years. Resembling in part our latest battleships, they will not have casemates, but a citadel will extend for about three-fifths of the length of the vessel. The side plating will be of 6-inch cemented armor from about five feet below the water-line right up to the main deck. On the water-line, however, there will be forward and abaft the citadel to the bow and the stern armor plating tapering from four inches to three inches in thickness, the usual armored bulkheads forming the bow and stern 'thwartship walls of the citadel. The armored deck will, as hitherto, be curved to the bottom of the side plating, thus increasing the effective protection on the broadside against gun attack. At each corner of the citadel will be mounted a 9.2 27-ton gun, and in addition there will be mounted a gun of the same calibre forward of the citadel and another abaft the citadel. These two will have gun-houses of 6-inch armor protecting the gun mountings and other mechanism, with an armored floor and an armored ammunition tube. There will thus be afforded the maximum of protection to the isolated guns. The arrangement of the six guns will enable three 9.2-inch guns to fire ahead and three to fire astern without interfering with each other's sighting. In addition to these six large guns there will be mounted ten quick-firers of 6-inch calibre—five on each broadside upon the main deck between the 9.2-inch guns at the ends of the citadel. The battery of six 27-ton and ten 6-inch quick-firing guns makes the Duke of Edinburgh and the Black Prince the most formidable cruisers, so far as gun power is concerned, yet constructed. Hitherto our larger ships have had only two 9.2-inch guns—one for bow and the other for stern chasing. But in some of the cruisers of Continental powers there has been a greater disposition to increase the number of larger weapons, even in some cases at the expense of secondary armament. Although the displacement tonnage of the Duke of Edinburgh is less than that of the Drake, being 13,500 tons, as compared with 14,100 tons, there is an increase in the weight of shot which may be fired per minute of from 15,840 lbs. to 17,120 lbs., and in the total collective muzzle energy from 766,720 to 828,800 foot tons. The Devonshire class of cruisers fire 10,000 lbs. of shot per minute, with an energy of 488,400 tons. The machinery is to be of the triple-expansion type, with one cylinder of 43½ inches, a second of 69 inches, and two others of 77 inches in diameter, the stroke being 42 inches, and the engine power of 23,500 I. H. P. is expected to be realized when the engines are making 135 revolutions. At this the speed of the ship will be 22½ knots. There will be in each ship twenty Babcock and Wilcox boilers, having 51,000 square feet of heating surface, and 1400 square feet of grate area, along with six cylindrical boilers with 11,250 feet of heating surface, and 360 square

feet of grate. In one of the ships the tank boilers will be fitted with Howden's forced draft. The boiler pressure will be 210 lbs., and the initial pressure at the engines 205 lbs.—*United Service Gazette*, January 3, 1903.

The Admiralty have placed orders for the two third-class cruisers of this programme (Diamond and Sapphire) with the Palmer Shipbuilding Company, Jarrow, and Messrs. Laird Brothers, Birkenhead. These vessels are improved Pelorus cruisers, having a displacement of 3000 tons, their length being 360 ft., their beam 40 ft., while their draft at full load will be 14 ft. 6 in. The Palmers' boat will be fitted with the Reed small-tube boiler, which has given such satisfactory results in torpedo-boat destroyers, and the Laird boat will have Laird-Normand boilers, also largely used in the destroyers built by the firm on the Mersey. Both vessels will have reciprocating engines with high pressure cylinders 14¼ in., three intermediate cylinders 38½ in., and two low pressure cylinders 42¼ in. with a stroke of 24 inches. Running at 250 revolutions, the engines will indicate 9800 indicated horsepower, which, it is anticipated, will give the vessel a speed of 21¾ knots. The vessels will depend for protection on an armored deck, and for armament will have 12 quick-firing guns of 4-inch calibre, eight 3-pounders, and three Maxims, with two torpedo-launching tubes under the water-line. The vessels are to be completed in 21 months, heavy penalties being specified for late delivery.

Consistent with the general Admiralty policy, it has been decided to increase the gun power of the new "scouts" in excess of that originally decided upon. Then, six 12-pounder guns were accepted as the main armament of the ships, but now ten of these guns are to be fitted, and they will be so placed as to command a very wide range. In addition there will be eight of the now famous pom-pom guns, while on deck there will be mounted torpedo tubes to fire 18-inch torpedoes from either broadside. The exact dimensions of the vessels are as follows: Length, 360 ft.; breadth, 40 ft.; with a mean draft of 14 ft. 2 in., when the displacement will be 2900 tons. The speed of 25 knots is to be realized, when the two sets of engines are indicating 17,000 H. P. The vessels will carry at their full draft 300 tons of coal, but on trial they will only have 165 tons. They will be able to steam a distance equal to the Atlantic voyage at 10 knots speed, while at full speed they will be able to travel over 200 miles. Their chief structural characteristic will be the long forecastle, which is to be built with a turtle back, their three raking funnels and one pole mast. There will be no bulwarks, rails being substituted for these. They are to have a continuous protective deck of 1½ in. in thickness, sloping at the sides to under the water-line. They will also be fitted with an armored conning tower, so that for the limited displacement they will be exceptionally powerful ships.—*United Service Gazette.*

Very extensive work is to be carried out on the Terrible when she goes round to Messrs John Brown & Co.'s works at Clydebank, where she will arrive about the 16th inst. Not only will the 48 boilers and machinery be thoroughly overhauled and many of the fittings of the ship renewed, but important structural alterations will be made, and the gun power increased by the addition of four 6-inch quick-firers. As originally built, the Terrible had two single-story casements in the waist of the ship on the main deck. Over these on the upper deck a casemate will now be built with 6-inch armor, so that there will then be, as in the Drake class, four two-story casemates on each broadside, each with 6-inch quick-firing guns.—*United Service Gazette.*

Casemates are to be fitted to the upper deck guns of the St. George, Edgar, Endymion, Crescent, Royal Arthur, Theseus, Grafton, and Hawke. All the old 6-inch guns will be removed, and the new 6-inch Mark VII substituted. The weight of the new casemates will be approximately 110 tons, or subtracting for the old shields, say, 100 tons net. The Mark VII guns are rather heavier than the current pattern, running to something like 15 tons each, gun and mounting, but as they take a "bare" charge instead of the old brass cartridge case, a great saving of weight will be effected here, and the net total increase of weight to the ships of a trifling nature.—*Engineer.*

The St. George and her sisters are perhaps the best cruisers we ever built, and though over ten years old no cruiser since built has been able to race them save on paper for more than a few minutes. Therefore they are well worth modernizing; while a virtue in them peculiarly felt just at present is that they have not got Belleville boilers.—*Engineer.*

The following is the subject for the Royal United Service Institution Gold Medal Prize Essay for the year 1903: "In the existing state of development of warships, and of torpedo and submarine vessels, in what manner can the strategical objects, formerly pursued by means of blockading an enemy in his own ports, be best attained?"

THE NEW SCHEME OF NAVAL REFORM.—The First Lord of the Admiralty's anxiously expected memorandum dealing with the entry, training and employment of officers and men of the Royal Navy and of the Royal Marines, was issued as a Parliamentary paper on Christmas Eve.

The essential features of the scheme may be thus summarized:

Every officer in future, whether he is to become an executive, engineer, or Royal Marine, will go through a common system of training, largely mechanical, from twelve to thirteen, lasting seven years.

Consequently—Engineers will gain experience in controlling men, in watch-keeping on deck, and in gunnery and torpedo work, while they will also have increased pay and combatant rank. Executive officers will have a good working knowledge of marine engineering and of applied science. Royal Marine officers will be more useful afloat in consequence of their early-acquired mechanical and seamanlike knowledge, and they also are to have their pay augmented.

Sixty warrant officers—men risen from the lower deck—will be given lieutenants' commissions.

Of late years the age at which cadets have joined the Britannia has been gradually raised to a maximum of 15½ years, and the course has been reduced to a period of only 15 months. It was hoped that the public schools would find it advantageous to devote special attention to the preparation of lads for service as executive officers, but the experiment has not been successful. Naval engineers have hitherto joined the Engineering College at Keyham at from 14½ to 16½ years, and have, consequently, had no sea training, and have lacked the essential preparation for the command of men; while Royal Marine officers, entering the corps at sixteen to eighteen years of age, have made no acquaintance with the conditions of life afloat until they have gone through their military course, and have been equally unfit with the engineers to take an adequate share in the executive and other work on board a man-of-war. Of the Royal Marine and executive officers it is also true that, while the material of the navy has changed, the old wooden walls have given place to modern steel ships, crammed with machinery, they have been afforded no opportunity of acquiring an adequate knowledge of even the rudiments of mechanics.

The problem of bringing these officers into sympathy with their envi-

ronment has been beset with difficulty and danger, for the Board of Admiralty has been conscious of the supreme importance of preserving to the naval officer his unmistakable naval character. To quote Lord Selborne: "This character is developed from the early training in responsibility, the powers of self-reliance thereby engendered, and the essential unity of the service. Notwithstanding the fact that during the transition period the system of naval education has been the subject of much criticism, the character of the naval officer has remained unimpaired, and character is of more value than knowledge. Now, however, as always, the highest type of naval officer is that wherein great professional knowledge is added to force of character. The danger within the navy itself is lest insufficient importance should be attached to the results of study, and lest the value of what is called the practical character should be placed higher than it deserves. The strength which its unity gives to the service can hardly be over-estimated, yet in respect of this very matter a strangely anomalous condition of affairs exists. The executive, the engineer, and the marine officers are all necessary for the efficiency of the fleet; they all have to serve side by side throughout their career; their unity of sentiment is essential to the welfare of the navy; yet they all enter the service under different regulations, and they have nothing in common in their early training. The result is, that the executive officer, unless he is a gunnery or torpedo specialist, has been taught but a limited amount of engineering, although the ship on which he serves is one huge box of engines; that the engineer officer has never had any training in executive duties; that from lack of early sea training the marine officer is compelled sorely against his will to remain comparatively idle on board ship when everyone else is full of work; and that the spirit of unity has not yet been carried to its full development."

With a full consciousness of the responsibility resting upon them, and after careful thought, the Lords Commissioners have decided on changes "far-reaching and in some respects sweeping," but they urge that "the scheme which necessitates them is framed in pursuance of a definite policy, is planned on clear lines, is designed to deal with the problem as a whole, and is throughout conceived in a spirit of veneration for all that is best and highest in the traditions of the service." The proposals are based on the principle that if a boy is to become a good naval or marine or engineer officer, he must begin his career young, when his habits and his thoughts are as yet unformed, and that all future officers of the navy and marines must be run through the same mould, so as to promote that unity of the service which was the secret of its success in the last great wars. In future, therefore, each of the three great departments will have the same system of supply, the same system of entry, and the same system of training. The scheme provides: All officers for the executive and engineer branches of the navy and for the Royal Marines shall enter the service as naval cadets under exactly the same conditions, between the ages of twelve and thirteen. That these cadets shall all be trained on exactly the same system until they shall have passed for the rank of sub-lieutenant between the ages of nineteen and twenty. That at about the age of twenty these sub-lieutenants shall be distributed between the three branches of the service which are essential to the fighting efficiency of the fleet—the executive, the engineer, and the marine. The result aimed at is, to a certain point, community of knowledge and lifelong community of sentiment. The only machinery which can produce this result is early companionship and community of instruction.

The new scheme, apparently, means the dethronement of the naval crammer, who has been in the habit of preparing the older lads of to-day for the Britannia. The examination for future cadets will be simple, and will not be regarded as more than a "preliminary canter," a mere formality, to guarantee that the boys who will enter on official nomination,

as at present in the case of Britannia cadets, have at least average intelligence:—The entrance examination for the Royal Naval College, commonly known as the "Britannia" examination, will be of an elementary kind, and confined to those subjects in which a carefully-educated boy has usually been instructed up to the age of thirteen. No change will be made in the present system of enterings boys for the competition, but the medical evidence is conclusive that at this early age the examination must not be severe, and indeed that no examination of boys at this age or at the later age now obtaining can be considered an accurate test of what their comparative faculties will be when they have attained manhood. It consequently follows that, during their period of training at the Royal Naval College, cadets who fail to attain a minimum standard or to show promise of sufficient development of intellect must be requested to withdraw.

The new course of preliminary training, when the foundations of a sea career will be laid, will be thus divided up:

Britannia or its successor, the Royal Naval College.........	4 years.
At sea as midshipmen (for sea training, and further instruction in mechanics and other applied sciences, and marine engineering	3 years.
At Greenwich College, as sub-lieutenants (for mathematics, navigation, and pilotage)............	3 months.
At Portsmouth Naval College (for gunnery, torpedo, and engineering	6 months.

Every future officer, executive, marine, and engineer, will go through this course, and he will be transformed from the thoughtless schoolboy into the young seaman, scientist, gunner, torpedoist, engineer, and soldier, and the foundation will have been laid for the special studies to which he will thenceforward devote his time.

As this common training is the essential feature of the new scheme, it may be well to set out the particulars in full: Cadets will remain under instruction at the Royal Naval College for four years before going to sea, and they will all receive similar instruction, which will comprise an extension of the Britannia course, including elementary instruction in physics and marine engineering, with the use of tools and machines in connection therewith. The object of this course will be to give them a good grounding in the subjects necessary to their profession, and at the same time such a general education as will enable them to grasp the theory of their future subjects of study, whichever branch they may eventually join. At the end of this period the cadets will go to sea and become midshipmen (Britannia time counting, as at present). Special attention will then be paid to their instruction in mechanics and the other applied sciences, and to marine engineering. The instruction of the midshipmen in seamanship will be given as at present by an executive officer deputed by the captain; otherwise it will, under the general responsibility of the captain, be supervised by the engineer, gunnery, marine, navigating and torpedo lieutenants of their respective ships; they will be examined annually as to their progress in seamanship, navigation and pilotage, gunnery, torpedo work, and engineering, all set papers being as at present sent from the Admiralty; and at the end of three years every midshipman who has passed the qualifying standard at the last annual examination and the final examination in seamanship before a board of three captains or commanders (constituted as at present) will become an acting sub-lieutenant and return to England. These acting sub-lieutenants will then go to the college at Greenwich for a three months' course of mathematics and navigation and pilotage, followed by an examination, and afterwards to Portsmouth for a six months' course in gunnery, torpedo, and engineering, at the close of which they will be examined, receive their classification, 1, 2, 3 in each subject, and on passing out be confirmed in the rank of sub-lieutenant. Before the period

arrives at which the first batch of cadets under the new system have to go to sea, the board will have considered very carefully and will have decided whether they shall be sent for the whole three years as midshipmen to battleships and cruisers, ordinarily commissioned, or whether the first part of this period shall be passed in specially commissioned training ships. It is quite decided that at whatever period they are posted to ordinarily commissioned battleships and cruisers compulsory school on board these ships shall cease. When the young officers, aged nineteen to twenty, have passed out of the college at Portsmouth at sub-lieutenants, and have gained their classification in the different subjects of the examination, their careers for the first time will begin to diverge, and they will be posted to the executive or to the engineer branch of the navy or the royal marines. As far as possible each officer will be allowed to choose which branch he will join, but this must be subject to the proviso that all branches are satisfactorily filled. No sub-lieutenant will be compelled to join a branch for which he did not enter as a boy when applying for a nomination, but in giving nominations for competition for entrance to the Britannia preference will (other things being equal) be given to those boys whose parents or guardians declare for them that they will be ready to enter either of the three branches of the service. The Board of Admiralty will thus have in reserve a means a remedying a surplus or deficiency in either of the three branches, and of insuring that every branch receives a due proportion of the most capable officers. Up to this point the young officers' characters have been formed in one school, and all these sub-lieutenants have received as the foundation of their professional education that common knowledge which all alike require. Henceforward their education must be differentiated to make them fit to perform those specialized duties which are the product of modern science.

The foundation of the cadets' careers having been thus laid on a sure, broad basis they will be divided among the several branches, some being selected as executive officers, some as engineers, and some as Royal marines, and will undergo special courses of study. As to the engineers, it is stated: The ranks of engineer officers will be assimilated to the corresponding executive ranks, and they will wear the same uniform and bear the same titles of rank—Sub-lieutenant (E.), lieutenant (E.), commander (E.), captain (E.), and rear-admiral (E.). The engineer branch will receive additional pay, and "although it is proposed to make the division into the various branches definite and final, every endeavor will be made to provide those who enter the engineer branch with opportunities equal to those of the executive branch, including the same opportunities of rising to flag rank. Promotion up to the rank of captains (E.) will be by selection and qualifying service, and lieutenants (E.) will have to pass a qualifying examination before becoming commanders (E.). The proportion of different ranks in the engineer branch will, as far as possible, be assimilated to that which will be fixed for the executive branch. . . . . The endeavor will also be made to find a suitable number of high appointments for the flag officers of the engineer branch."

On the future of the Royal Marine officers Lord Selborne remarks: As in the case of the executive lieutenants, specially good officers will qualify as gunnery and torpedo lieutenants, provided that they have kept watch at sea for one year, have passed the test examination for qualifying for gunnery and torpedo lieutenants, and been specially selected and recommended. For the purposes of promotion and seniority in the corps all these officers will be on one list and not divided into two lists as now is the case with officers of the Royal Marine Artillery and the Royal Marine Light Infantry. Ashore the Royal Marine and naval officers will take command over one another, according to their seniority in their corresponding ranks. The pay of Royal Marine and naval officers afloat will

be equalized. The object to be aimed at is that there may be the same proportion of employment in the higher ranks and the same proportionate flow of promotion for the officers of the Royal Marines as for those of the executive and engineer branches of the navy. Henceforward the efficient military and marine officer will exist as of old, but with this difference—that from the very outset of his career as such he will be competent to take a much fuller part in the handling and fighting of his ship than his present training has permitted.

The result of the new system of training will be that whereas "the cadet now takes 4½ years to become an acting sub-lieutenant, under the new system he will become fitted for the general services of the fleet in seven years, while the engineer and Royal Marine officer will require about two years more for their special professional instruction." The new system will be introduced in midsummer, 1903, and for a time there will be double entries—under the old and new schemes—for 2½ years in the case of the existing type of cadet, six years for the Royal Marine Light Infantry, and five years for the Royal Marine Artillery and the engineer students, so as to bridge over the necessary interregnum. The younger cadets will be trained in this period at Osborne.

Meantime what is to happen to the existing engineer officers and those of the Royal Marines? On this point Lord Selborne states that "the board are confident that the naval engineer officer of the future will maintain to the full the high traditions of the present engineer branch, but they feel that this scheme would not be complete if it did not include changes designed to harmonize as far as possible the position of the present officers of the engineer branch with the spirit of the future organization." The following changes in the rank of existing officers will be made: Engineer students will become engineer cadets, and the college at Keyham will be known as the Royal Naval Engineering College. Assistant engineers for temporary service and assistant engineers will become engineer sub-lieutenants. Engineers, chief engineers and staff engineers will become engineer lieutenants. Fleet engineers will become engineer commanders. Inspectors of machinery will become engineer captains, and chief inspectors of machinery will become engineer rear-admirals. The engineer-in-chief will become an engineer rear-admiral, and the Board reserve power to promote the officer holding that high post to the rank of engineer vice-admiral if thought advisable.

As to other matters affecting the existing officers of this branch, the First Lord states: The average period of reaching each rank will be assimilated as far as possible to that of the executive branch, so as to correct the present disparity of age which too often obtains between officers of the two branches of relatively equal rank; the pay of existing engineer officers will be raised, but no changes will be made in their uniform or in the regulations which define their duties or in the provisions of the Naval Discipline Act. The Board have given their careful and earnest consideration to all the suggestions which have been made from a variety of quarters for further changes affecting the present engineer officers. The decision at which they have arrived is, they are convinced, that most conducive to the interests of the service as a whole.

What, again, will be the fate of the existing officers of the Royal Marines? "The comparative non-utilization of the services of the marine officer on board ship," it is pointed out, "has long been a matter of regret on the part of successive First Lords and successive Boards of Admiralty; but his want of early sea training and his want of knowledge of the general duties of the ship when first embarked have hitherto rendered the young marine subaltern unable to take any responsible part either in the general work or in the navigation of the ship. The sole reason, therefore, of the comparative non-utilization of the marine officer's services on board ship has been his purely military training. This condition of

Engineer Officers.

FUTURE.

Rank.	Pay per Diem. s.	d.
Lieutenant (E.)	12	0
Of 4 years	14	0
Of 8 years	16	0
Of 10 years	17	0
Of 12 years	18	0
Of 14 years (max.)	20	0
Commander (E.)	24	0
Of 2 years	27	0
Of 4 years	30	0
Of 6 years	33	0
Captain (E.)	35—40	0
Real-Admiral (E.)	60	0

EXISTING OFFICERS.

Engineer Lieutenant	10	0
After 2 years	11	0
After 4 years	12	0
After 6 years	13	0
After 8* years	16	0
After 10 years	17	0
After 12 years	18	0
After 14 years	20	0
Engineer Commander	24	0
After 2 years	27	0
After 4 years	30	0
After 6 years	33	0
Engineer Captain	35—40	0
Engineer Rear-Admiral	60	0

Marine Officers.

FUTURE.

Rank.	Pay per Diem. s.	d.
Lieutenant	10	0
After 4 years in rank	11	0
Captain	12	0
After 1 year in rank	13	0
After 5 years in rank	15	0
Major	20	0
After 2 years in rank	22	0
After 4 years in rank	24	0
After 6 years in rank	26	0
Lieutenant-Colonel	30	0
After 2 years in rank	33	0
After 4 years in rank	36	0

Colonels 2nd Commandant will receive pay of rank and an additional allowance of 5s. per diem.

Colonels Commandant will receive pay at present rates, with an additional allowance of 12s. a day.

* This pay of 16s. a day, together with the right to wear the uniform of the increased rank of engineer-lieutenant of eight years' seniority, will be dependent on his obtaining a qualifying certificate and on being selected.

EXISTING OFFICERS.

Rank.	Artillery Pay per Diem. s.	d.	Infantry Pay per Diem. s.	d.
Lieutenant	6	4	5	11
After 3 years	7	5	7	0
Captain	12	1	11	7
After 1 year	12	7	12	1
After 5 years	13	1	12	7
After 8 years	14	7	14	1
Major	16	1	15	7
After 2 years	17	6	17	6
After 4 years	18	0	18	0
After 6 years	18	6	18	6
Lieutenant-Colonel	21	0	21	0
After 2 years	21	9	21	9
After 4 years	22	6	22	6

Colonels 2nd Commandant will receive pay of rank and an additional allowance of 5s. per diem.

Colonels Commandant will receive pay at present rates, with an additional allowance of 12s. a day.

As regards the scales of pay, it will be observed that the commandants Royal Marines will receive 12s. a day, corresponding to the command money of captains commanding naval establishments on shore, and the second commandants will receive 5s. a day.

The Secretary of the Admiralty announces for the information of parents and guardians that the new scheme of entry and training of executive and engineer officers of the Royal Navy and officers of the Royal Marines, by which all candidates for commissions will enter as naval cadets, under identical conditions, between the ages of 12 and 13, will be introduced in July, 1903, when the first examination will be held. During the period of transition from the existing to the new regulations the examination of candidates will be held under both regulations three times a year at the customary dates. Under the new scheme, a candidate will not be eligible for the examination in July who is less than 12 nor more than 13 years of age on the 15th of September following, nor for the examinations in November or March who is not within those limits of age on the 15th January or 15th May following, respectively. Under the old scheme: The last examination for naval cadets entering the Britannia at the ages of 14½-15½ will be held in November, 1905. The last examination for engineer students entering the Engineer Students' Training College at Keyham of the ages of 14½-16½ will be held in March, 1906. The last examination of candidates for commissions in the Royal Marine Artillery of the ages 16-18 will be held in June, 1908. The last examination of candidates for commissions in the Royal Marine Light Infantry of the ages of 17-19 will be held in June, 1909.—*United Service Gazette.*

Following up the memorandum dealing with the entry, training, and employment of officers and men of the Royal Navy and Royal Marines, the Admiralty have issued a circular letter for the guidance of commanding officers of ships that are allowed Royal Marine officers. The Admiralty are of the opinion that the services of officers of the Royal Marines, embarked on H. M. ships might with advantage be utilized in connection with the general routine work on board to a greater extent than is at present the practice. The duties mentioned below suggest themselves to their lordships as those which might most usefully be undertaken by officers of the Royal Marine Artillery and Royal Marine Light Infantry when their services can be spared from their work in connection with the marine

detachment of which they form part: (1) Assisting the gunnery-lieutenant generally as regards guns, small arms, physical drills, and gymnastics; and in charge of a division of guns, at quarters, whether manned by seamen or marines. (2) Officers of the guard when the duty is not of a nature requiring a naval officer. (3) Officer in charge of parties landed for work on shore, also in charge of picquets and patrols. (4) Wireless telegraphy under the torpedo-lieutenant, when one is borne; and in charge (after instruction) in ships which carry a marine officer but no torpedo officer. (5) Submarine mining, under torpedo-lieutenant (after a course of instruction). (6) Marking at target practice. (7) Intelligence officer. To keep N. I. D reports up to date, and to observe and point out every new matter affecting them. (8) In the case of junior marine officers, attendance at all drills with their men. The Admiralty, while pointing in what ways a more extended use might be made of the services of officers of the Royal Marines on board ship, state that they do not desire to lay down any hard and fast rules as to the actual duties for which the officers shall be detailed. It is their lordships' intention that the manner and extent of the employment of these officers on work in connection with the ship's routine shall be left entirely to the discretion of the commanding officer.

The navy estimates for 1903-1904 are £34,457,500, an increase of £3,202,000 over those of 1902-1903, and the largest on record. The building programme includes three battleships, four armored cruisers, three small cruisers, four scouts, fifteen torpedo-boat destroyers and ten submarine boats, against two battleships, two armored cruisers, two small cruisers, four scouts, nine torpedo-boat destroyers, and four submarine boats last year, besides four miscellaneous vessels. An increase of 4600 men is provided for.

The Admiralty announces that in the future all able seamen will get some mechanical training and a knowledge of stoking. For the purpose of encouraging proficiency in shooting the Admiralty will award a medal and a bonus to the captain of each type of gun on each ship who is adjudged by the ship's captain to be the best shot with his type of gun. More time will be devoted to the instruction of boys in gunnery. The Admiralty is being reorganized to make it more effective in the event of war, and the naval intelligence department is being strengthened.

In addition to the reorganization of the home fleet, virtually creating a new squadron, an entirely new squadron will be formed to be called the South Atlantic Squadron, with bases at Gibraltar and Sierra Leone. This squardon will operate on the southeast coast of America and the west coast of Africa, the latter being severed from the Cape station.

Despite the storm of criticism with which it has been assailed, the large-displacement battleship continues to grow both in size and in favor. Proof of this is to be found in the huge 18,000-ton ships which are to form the most important feature of the new building programme of the British navy. In 1882, six battleships were included in the British naval construction estimates, each of 10,600 tons. In 1892, the displacement had risen to 14,150 tons, which was the size of the Royal Sovereign class. Then followed the Majestic class of 14,000 tons; the Formidable class of 15,000 tons, and the King Edward class of 16,350 tons; while to-day the designs for 18,000-ton battleships will soon be in the builders' hands. The policy of building battleships of large size is favored in our own navy, the Connecticut and Louisiana having a displacement of 16,000 tons.

In other respects than that of size, there is a tendency on the part of American and British designers to reach a common type, with certain clearly marked characteristics. This is particularly noticeable in a comparison of the new 18,000-ton ships with our own 16,000-ton vessels, for it must be confessed that in these last ships the British designers have

shown a desire to follow our lead in the make-up and disposition of the armament, as will be seen from the following description:

The main armament of the new ships will consist of four 12-inch guns, located in two barbette turrets, forward and aft, and eight 9.2-inch guns, mounted in four barbette turrets, one at each corner of a central citadel, within which will be carried ten 6-inch rapid-fire guns. This armament will be more powerful than that of the King Edward class by four 9.2-inch guns. As compared with the Connecticut, it will be seen that the armament will be about the same in power; for while the eight 9.2-inch guns constitute a much more powerful battery than the eight 8-inch guns of the Connecticut, this preponderance is largely offset by the fact that the Connecticut carries twelve 7-inch guns as against the ten 6-inch guns of the British vessel. The 8-inch gun is very popular with the officers of our navy, and it is amply sufficient for the attack of armor covering the secondary batteries of the latest foreign vessels. On the other hand, the 9.2-inch is a much more powerful piece; it throws a 380-pound projectile with a muzzle velocity of 2900 feet per second, and a muzzle energy of 22,160 foot-tons. Our new naval 8-inch piece of 45 calibres throws a 250-pound shell with a velocity of 2800 feet per second, and an energy at the muzzle of 13,602 foot-tons. The lower power of our piece would be compensated for somewhat by the greater rapidity with which it can be handled; on the other hand, the 9.2-inch gun can pierce any water-line armor afloat at ordinary fighting range. The total muzzle energy of a single round from the main batteries would be 409,552 foot-tons for the Connecticut and 417,680 tons for the 18,000-ton ships.

It is chiefly to the increase of its defensive qualities that the extra 2000 tons displacement of the British ship has been devoted, the protection being of quite an exceptional nature. In addition to the protection of 9 inches of Krupp steel from stem to stern at the water line, this 9-inch armor covers the whole side of the vessel to the upper deck, giving the equivalent of water-line protection to the whole of the 6-inch battery, the bases of the 9.2-inch and 12-inch gun barbettes, and to the ammunition hoists and the bases of the smokestacks. The whole of the personnel will therefore fight the ship from behind not less than 9 inches of Krupp steel. The speed of these huge vessels is to be 19 knots, and they will each cost $7,000,000 to build and equip.—*Scientific American.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
Duca di Genova (A)	12,625	Gov't Yard, Spezia.	Building.
Ducca d'Aosta (B)	12,625	Gov't Yard, Castellamare.	"
Duca degli Abbruzzi, (C)	12,625	Gov't Yard, Venice.	"
Vittorio Emanuele	12,625	Gov't Yard, Spezia.	Not yet launched.
Regina Elena	12,625	Gov't Yard, Castellamare.	Not yet launched.
Benedetto Brin	13,526	Gov't Yard, Castellamare.	Launched Nov. 7, 1901.
Regina Margherita	13,526	Gov't Yard, Spezia.	Launched May 30, 1901.
ARMORED CRUISER.			
Francesco Ferruccio	7,460	Gov't Yard, Venice	Launched April 30, 1902.
TORPEDO CRUISER.			
Coatit	1,313	Gov't Yard, Castellamare.	Under trial.
TORPEDO BOAT DESTROYERS.			
Aquilone	350	C. T. T. Pattison, Naples.	Launched Oct. 16, 1902.
Borea	350	" " "	Launched, Feb., 1903.
Meteoro	350	" " "	Not yet launched.
Tuono	350	" " "	" " "
Espero	350	" " "	Building.
Zeffiro	350	" " "	"

A new battleship of the type of the Vittorio Emanuele, but slightly modified, will soon be laid down at Spezia. Her name is to be Roma.—*Le Yacht,* Jan. 10, 1903.

The Engineer of February 27 states that the names of the three new battleships (A, B, C) as given above are incorrect; that the one building at Castellamare is to be called Napoli, the one building at Spezia is to be called Roma, and that the third ship is merely projected, not yet begun.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
1, 2, 3, 4	15,000	....	To be built 1904-1909.
ARMORED CRUISERS.			
1, 2	9,900	....	" " "
PROTECTED CRUISERS.			
3, 4, 5, 6	5,000	....	" " "
A (?)	....	Clydebank. (?)	Designs not known.
B (?)	....	" (?)	" " "
Niitaka	3,470	Yokosuka.	Building.
Tsuchima	3,470	Kure.	"
TORPEDO BOAT DESTROYERS.			
Asashio	320	Thornycroft, England.	Under trial.
Kasumi	360	Yarrow, "	" "
Shiakumo	320	Thornycroft, "	" "
Akatsuki	360	Yarrow, "	" "
Asagiro	375	Yokosuka.	Building.
Harusame	375	"	"
Hayatori	375	"	"
Murasame	375	"	"

The Yacht of February 14, 1903, states that the trial speeds of the Thornycroft and Yarrow destroyers were as follows: Asashio, 7274 horsepower, 31.04 knots; Kasumi, 6500 horsepower, 31 knots; Shirakumo, 31.03 knots; Akatsuki, 31.12 knots.

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
BATTLESHIPS.			
......	16,000	St. Petersburg.	Building. Complete 1905.
X	16,000	....	Projected.
X	16,000	....	"
X	16,000	....	"
X	16,000	....	"
Imperator Alexander III.	13,516	St. Petersburg.	Launched Aug., 1901.
Borodino	13,516	"	Launched Sept., 1901.
Orel	13,516	"	Lchd. July, 1902; compl. 1904.
Kniaz Suvarof	13,516	"	Lchd. 1902; complete 1904.
Slava	13,516	"	Building.
Tsarevitch	13,100	La Seyne.	Under trial.
X	12,585	Nicolaiev.	Building.
COAST DEFENCE IRON CLAD.			
Admiral Boutakof	6,000	St. Petersburg.	Building.
PROTECTED CRUISERS.			
Oleg	6,750	St. Petersburg.	Building.
Kayul	6,750	Nicolaiev.	Launched. (?)
Otchakof	6,750	Sevastopol.	Launched Oct., 1902.

VESSELS BUILDING.—CONTINUED.

Name.	Displacement.	Where Building.	Remarks.
X	6,000	St. Petersburg.	Building.
X	6,000	"	"
Aurora	6,730	"	Under trial.
Diana	6,730	"	" "
Boyarin	3,200	Copenhagen.	" "
Kalgoula	3,200	Nicolaiev.	Building.
Almaz	3,200	St. Petersburg.	"
Jemtchug	3,200	"	"
Izumrud	3,200	"	"
7	3,200	Dantzic (Schichau).	"
8	3,200	St. Petersburg.	Projected.
TORPEDO BOAT DESTROYERS.			
Baklan	350	St. Petersburg.	Building.
Bekass	350	"	"
Gorlitsa	350	"	"
Kulik	350	"	"
Perepel	350	"	"
Skvorets	350	"	"
Strij	350	"	"
Chtchegol	350	"	"
Albatross	350	"	"
Drozd	350	"	"
Diatel	350	"	"
Bezuprechin	350	"	Launched 1902.
Zhivoi	350	Nicolaiev.	Building.
Zhioulka	350	"	"
Zlatky	350	"	"
Zhiasky	350	"	"
Zavidni	350	"	"
Zavetni	350	"	"

The armored cruiser Slava, the keel of which was laid on November 1 on the Baltic Shipbuilding Yard on the Neva, will have the following dimensions: Length, 397 feet; beam, 76 feet; depth, 26 feet, and displacement, 13,516 tons. The engines are to develop 15,800 horsepower; the armament will consist of four 12-inch, twelve 6-inch, twenty 75 mm., two 37 mm., and ten quick-firing guns. On the same day the new transport-ship Kamchatka was launched from the New Admiralty Yard; her dimensions are: Length, 395 feet; beam, 49 feet; depth, 22 feet. Her rate of speed will be only 12 knots. The ironclad Cesarevitch, now being built by the Mediterranean Forge and Shipbuilding Company of Toulon, will not reach Cronstadt before the spring.—*United Service Magazine.*

The 16,000-ton Russian ships seem definitely decided upon. Four 12-in., twelve 8-in., and twenty 12-pounders is the probable armament. A deal of the bulk is to be taken up in coal, and they are "to be able to steam from Kronstadt to Vladivostok without re-coaling." As the coal consumption of Russian ships on trials averages out to something like 1½ to 2 tons per knot, and the distance from Kronstadt to Vladivostok is, roughly, about 12,000 miles, it follows that the coal capacity of the new battleships will have to be 18,000 tons odd at least. As this exceeds the total displacement, the new ships ought to be interesting specimens of naval architecture. At reduced speed the consumption per knot would, of course be much less, but even with this limitation, the estimate of their range is extremely sanguine, not to say delusive.

The Odessa correspondent of the *Standard* writes that it is semi-officially announced that the Ministry of Marine has just completed a scheme for the rapid increase of the Russian navy in first-class battle-

ships and cruisers. All the resources and appliances of the Baltic yards will be requisitioned for the execution of the orders to be immediately placed in them. The ministerial project provides for the construction of five line-of-battleships of an average displacement of 16,000 tons, and three first-class cruisers, the tonnage of which is not yet stated. Each battleship is to carry four 12-in. and twelve 8-in. guns, besides an elaborate and heavy equipment of quick-firing ordnance. The new vessels will exceed in weight and armament the existing battleships and cruisers in the Imperial navy.—*Engineer.*

It is stated upon the best authority in Russia that a new shipbuilding programme has been prepared. The ships of the older programme appear to be all completed or in hand, and an announcement has been anticipated. There are to be five battleships approximating to 16,000 tons, and three first-class cruisers of large displacement. The battleships will be armed with four 12-in. and twelve 8-in. guns, and will have a large secondary and smaller armament. They will be more powerful than any vessels yet built for the Russian fleet, and it is intended that in design, materials, and equipment they shall be wholly of Russian origin, all the resources of the yards on the Neva being employed. The programme will also include some smaller cruisers and auxiliary vessels. The building of destroyers is always going on. The average time occupied in the construction of a Russian battleship appears to be nearly five years, and this is not likely to be greatly curtailed.—*Army and Navy Gazette.*

THE RUSSIAN CRUISER BOGATYR.—The following is a description of the Russian first-class protective-deck cruiser Bogatyr, built by the Stettiner Maschinenbau Actien-Gesellschaft Vulcan, of Stettin. This vessel is one of three for which competitive designs were invited by the Russian Government, under certain stringent conditions of power, speed, and stability, and the Vulcan Company not only complied with these, but increased the protection of the armament by placing the bow and stern chasing pairs of 15-centimetre guns in turrets, and by protecting four other weapons of the same calibre in casemates, instead of providing shields only for all 15-centimetre guns. The result was that in addition to ordering the Bogatyr from the Vulcan Company, the Russian Government began the construction of four cruisers on the Bogatyr plans in Russian yards—a compliment to the Vulcan Company and its directorate, which was not depreciated by the substantial remuneration to the company for the use of the designs.

We will defer our detailed description; the length over all is 439 ft. 7½ in.; on the water line, 433 ft.; and between perpendiculars, 416 ft. 8 in. The maximum breadth is 54 ft. 5¼ in.; and the moulded depth, 34 ft. 1¼ in. On a mean draft of 20 ft. 8½ in.; the displacement is 6750 tons, and thus loaded the Bogatyr maintained the high "mean of mean" speeds on the measured mile of 23.45 knots, with 20,161 indicated horsepower, although the air pressure in the stokeholds was only ½ in.; while the mean speed on two separate six-hours' trials was 24.15 knots, with 20,270 indicated horsepower, the coal consumption being 1.43 lb. per indicated horsepower per hour. Two sets of four-cylinder triple-expansion balanced engines drive the twin screw propellers, and the steam is generated in sixteen Normand "Express" boilers.

The armament is as follows:—Twelve 15-centimetre (5.9-in.); twelve 7.5-centimetre (2.95-in.); and eight 4.7 centimetre (1.85-in.) quick-firers. For use in the boats there are two 1.46 in. and two 0.28-in. machine guns, with two landing guns of 2.56-in. calibre. There are two submerged torpedo-tubes; four above water—two on each broadside, one through the ram bow, and the other in the stern; and there are two other tubes for boat duty.—*Engineering,* Jan. 30, 1903.

There has been built recently in the Howaldt shipbuilding yard at Diederichsdorf, near Kiel, and to the order of the Russian Government, a training-ship for preparing artificers and stokers for service in the Russian navy. This new ship, the Ocean, illustrated above, has recently gone through her trial trips. Although she is intended for Naval purposes, yet she has the look of an ordinary cargo steamer. She has three funnels, and she is fully brig-rigged in case of the total breakdown of the engines. The total length of her hull is 490 feet, and between the perpendiculars the length is 470 feet. Her greatest beam is 56 feet 9 inches, and her depth amidships is 36 feet 3 inches. When loaded the displacement of the Ocean is 11,897 English tons. Her engines are twin-screw, and indicate a total horsepower of 11,000. They are said to be able to give the vessel a speed of 18 knots when they are working with only 5600 indicated horsepower. The hull is built entirely of Siemens-Martin steel. The navigating bridge is built forward on the deck-bridge. It consists of an upper and a lower bridge, and between them are the chart-house and the steering-house. Immediately aft of the bridge are the funnels, which are surrounded by the engine and boiler ventilators. The vessel carries altogether fourteen boats, of which six are hung on ordinary davits and four on the so-called Barkunen davits. The forecastle is 97 feet long. The coal bunkers have a capacity of 81,125 cubic feet, and they can take in 1600 tons of coal. Her two masts are of steel, each 55 feet in height, each having three yards and the usual rigging, and being fitted with two derricks, each for taking in cargo. The pinnaces of the transport are driven by benzine motors, and are reported to attain a great speed. The cost of construction was nearly £250,000.—*Engineer,* January 2, 1903.

The *Novoie Vremya* says that with the arrival in the far East of Admiral Stackelberg's squadron, which visited Portland on its way out, the Russian naval forces in Chinese waters will be more powerful than at any previous period. There will be six battleships, eight first-class armored cruisers, four second-class cruisers, seven sea-going gunboats, two transports, three torpedo cruisers, and twelve destroyers or sea-going torpedo-boats, nearly all these vessels being of modern construction. It is stated that the Minister of War, General Kouropatkine, and the Minister of Finance, M. Witte, are about to pay a visit to the Russian possessions in the far East.

THE IMPERIAL RUSSIAN CRUISER BAYAN.—The new first-class armored cruiser Bayan has recently completed her trials most successfully off Toulon; her engines developing 17,400 I. H. P., or 900 H. P. over the contract, and giving the ship a speed of 22 knots, instead of the 21 knots guaranteed. Her Belleville boilers worked without a hitch. The ship has been built by the Forges et Chantiers de la Méditerranée, at La Seyne, near Toulon.

Her dimensions are as follows: Displacement, 7800 tons; length, 443 feet; beam, 55¾ feet; draft (mean), 22 feet; guns (all quick-firers), two 8-inch, eight 6-inch, 45 calibres, twenty 3-inch (12-pounders), seven 3-pounders; torpedo-tubes, two submerged, three above water.

The guns are all Russian, from Obuchoff; the torpedo-tubes, in the case of those submerged, are of the Elswick patent, which La Seyne has already had fitted to other of its ships.

Protection is afforded by a Krupp steel water-line belt, which reaches from the bow to the base of the mainmast, varies from 8 inches to 4 inches in thickness, and reaches from 4 feet below to 2 feet above the water-line, and is associated with a curved protective deck, which is 2 inches thick on the slopes. The belt is about 360 feet long, or a little more.

Above the water-line belt is a belt of thin armor protecting the lower deck. This is 3 inches thick, and extends 335 feet from the extreme bow. It will just keep out shell from 6-inch guns, but not shot. This belt protects the lower deck and two of the three above-water torpedo-tubes. The third tube, in the stern, is unprotected. The upper belt covers the lower deck and reaches to the main deck, upon which all the 6-inch guns are carried. On this deck there are three separate redoubts, all 3 inches in thickness. The forward and after ones both contain a pair of 6-inch guns, one on either side. The central and large redoubt contains four 6-inch guns, and also eight 3-inch 12-pounders, carried four each side. This is a novel feature. Above each 6-inch gun 12-pounders are carried behind shields. The remaining four are on the main deck—two well forward and two right aft. On the forecastle, and aft on the upper deck, are the two 8-inch guns, each in a closed balanced turret, 7 inches thick. The ammunition hoists of these are 3 inches thick. There is also a 3-inch tube protecting the voice-pipes, etc., from the conning-tower, which last is 6½ inches thick and placed rather high up.

All Russian ships carry plenty of searchlights. The Bayan has one in the foretop, one carried low on the mainmast, one in the bow under the forecastle, one in the stern, and one each side amidships carried on top of the central battery.

The engines are designed to work up to 16,500 I. H. P., with an estimated speed of 21 knots, which, according to contract, has to be maintained for 12 hours, and as we have stated above, has been exceeded by a knot. Steam is provided by twenty-six Belleville boilers, fitted with economisers, and placed in four groups. The stokeholds are eight in number, and each contains three boilers, except the aftermost pair, which contains four each. The coal carried is 750 tons, but there is a stowage room for 1100 tons. This—as with water-tube boilers the consumption for all purposes is approximately a ton a knot—gives the ship a full-speed radius of about 1300 miles, or, allowing for Russian stokers—say, 1000 miles, or 40 hours' steaming. It will also work out at about 3000 miles at 18 knots. Theoretically, of course, the radius is larger, but theoretical radii generally omit the chief item of consumption—auxiliary purposes. The Bayan has two screws. The ammunition carried is as follows: For each 8-inch gun, 100 rounds; 6-inch, 150 rounds; 3-inch, 250 rounds; 3-pounder gun, 500 rounds.

Launch.—The new first-class Russian cruiser Otckakov was launched in the presence of the Tsar at Sevastopol on October 4. Her dimensions are as follows:—Length over all, 439 feet 7½ inches; on the water-line, 433 feet 5½ inches; beam, 54 feet 5½ inches; draft, with a full load, 20 feet 7¼ inches; displacement, 6570 tons. The engines are to develop 19,500 H. P., steam being supplied by 16 Normand Sigaudy boilers, which with 150 revolutions, are to give a speed of 23 knots; normal bunker capacity, 720 tons; special, 1100 tons. In building her hull 2000 tons of Siemens-Marten steel have been used. The thickness of her armor deck will vary from ¾ inch to 2¾ inches; the thickness of the protection for her casemates will be 3⅛ inches; for her turrets, 5 inches; and for her conning tower, 5½ inches. Her armament will consist of twelve 6-inch guns of 45 calibres—four in turrets, four in casemates, and four with shields; twelve 2.95-inch guns; six 1.85-inch Hotchkiss guns; and two submerged torpedo-tubes. She will be fitted with eight turbines, worked by electric motors and capable of raising 3800 tons of water in an hour, and also with four pumps for the circulation of water in her boilers to the extent of 4000 tons in an hour. She was begun on March 7, 1901.—*Royal United Service Institute.*

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
PROTECTED CRUISERS.			
Reina Regente	5,372	Ferrol.	Building.
Isabel la Catolica	3,500	Canaca.	"

SWEDEN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
COAST DEFENCE BATTLESHIPS.			
Aran	3,650	Gothenburg.	Under trial.
Wasa	3,650	Malmö.	Launched.
Manligheten	3,650	"	Building.
Tapperheten	3,650	Stockholm.	Launched.
Dristigheten	3,450	Gothenburg.	Under trial.
ARMORED CRUISER.			
Fylgia	4,060	....	Building.

The new Swedish armored cruiser is named Fylgia. She is not very dissimilar to the projected cruiser we illustrated some time ago. The projected vessel, it may be remembered, was deck protected with eight single-gun turrets. In the Fylgia four twin turrets replace the eight single ones, and a 4-inch belt amidships consumes the weight thus saved. The point of prime interest about the Fylgia is that she marks Sweden's entry into the list of sea power nations. Till now the Swedish fleet, though of excellent efficiency, has been only designed for coast service. Now all that is changed, and the Fylgia—a sea-going cruiser—is the first breath of a new-born sea power. The matter does not primarily concern us, who have no designs on Sweden, but both Germany and Russia—especially Russia—may read into the change a great deal more import than appears on the surface.—*Engineer,* January 30, 1903.

TURKEY.

THE RECONSTRUCTED TURKISH BATTLESHIP MESSOUDIYEH.—The "reconstruction of the Turkish fleet" has for so many years shared honors with the big gooseberry and the sea serpent that very few people believe it will ever come to anything. Very possibly it never will; but Messrs. Ansaldo, of Genoa, have made a very decided beginning on the first vessel entrusted to them for modernizing. They have, in effect, taken an old battleship and converted her into a formidable armored cruiser, with the guns of the Cressy and the speed of the Majestic. There have been some pretty thorough "transformations"—to use the very apt French phrase—of late, but the Messuodiyeh out-Herods Herod very easily in the matter.

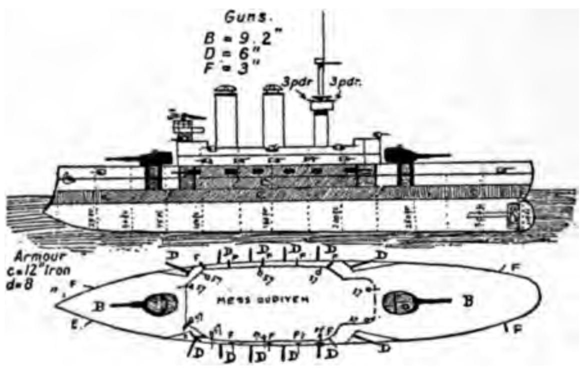
The Messoudiyeh, which is a sister ship to our Superb, was designed by Sir E. J. Reed, and launched on the Thames as long ago as 1874. She therefore belongs to the era of what, in our navy, are known as "prehistoric war-junks." She was of 9200 tons displacement, 331 feet over all, 315 feet between perpendiculars, by 59 feet broad, with a maximum draft of somewhere about 26 feet to 27 feet. For guns she carried a dozen 18-ton 9-inch muzzle-loaders in a central box battery; a couple of 6-ton 7-inch muzzle-loaders forward, and a similar pair aft. The battery was protected by 12-inch of iron armor, the belt varied from 12-inch to 8-inch. With 7431 indicated horsepower she reached a speed of thirteen knots on trial. She was one of the last single-screw ships to be built. The rig was that of a full rigged ship.

In those days this was a formidable ship, relatively equal, let us say, to the Canopus at the present time. By 1894, twenty years later, her value

had sunk to nil, partially owing to Turkish naval methods, partially to progress in naval warfare.

A few years ago the Sultan developed a personal interest in naval matters, and the result was that negotiations for the reconstruction of the Messoudiyeh were entered into with Messrs. Ansaldo. The ship was examined, found to have a good hull, but to be otherwise hopeless—the engines (if report speaks truly) being rusted away and fallen over in many places, and the boilers rather like sieves. With great difficulty she journeyed to Italy—a voyage that in novelty and excitement must have competed with the cruise of the Argo, so far as the Turks were concerned.

On arrival in Italy, after many delays due to Turkish indecision, the ship was taken in hand. The first and most difficult task concerned her stern. The old stern was cut away, and a new one of different underwater shape to carry twin screws substituted. Of this extremely interesting operation no details have reached us, and we do not know for



THE MESSOUDIYEH.

certain whether or no any lengthening was done. Presumably the ship was not lengthened, but a complete revolution was effected in her run aft.

Next, practically the entire old inside was taken out. The old bulwarks fore and aft, with the old poop and forecastle, were bodily removed. Amidships a light iron superstructure was built. New engines were designed for the hull and Niclausse boilers put in. For the twelve old 18-ton guns, a dozen 6-inch 45-calibre Vickers pieces were mounted. These use the old ports, slightly enlarged, and are fitted with 4-inch shields. Fore and aft barbettes were built on the "shallow tray" system, with 6-inch shields over them. In each a Vickers 40-calibre 9.2 was placed.

Ten 14-pounder 3-inch guns were placed in the upper deck superstructure, two more put on the main deck forward, and two others on the same deck in the stern. On the flying deck, over the superstructure, ten 57-millimetre guns (6-pounders) were mounted, and the new military mast carries a couple of 3-pounders.

On her trials this old ship which originally made but 13 knots easily exceeded 17, a performance that reflects upon Messrs. Ansaldo even more credit than the other portions of the work. We do not know the cost of this transformation, and cannot therefore venture an opinion as to whether better value might not have been obtained by the purchase of a new ship. Apart from that question, this reconstruction may pave the way to a new era, for it certainly indicates that no warship need be too obsolete or too ancient for conversion into a very respectable ship of the "second line."—*Engineer*, January 16, 1903.

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Displacement. Tons.	Knots.	Where Building.	Degree of Completion. Feb. 1.	Mar. 1.
				BATTLESHIPS.		
11	Missouri	12,500	18	Newport News Co.	84%	87%
12	Ohio	12,500	18	Union Iron Works.	69	70
13	Virginia	14,600	19	Newport News Co.	18	21
14	Nebraska	15,000	19	Moran Bros. Co.	15	16
15	Georgia	15,000	19	Bath Iron Works.	20	21
16	New Jersey	15,000	19	Fore River S. & E. Co.	26	29
17	Rhode Island	14,600	19	Fore River S. & E. Co.	26	28
18	Connecticut.	16,000	18	Navy Yard, New York.	1	1
19	Louisiana	16,000	18	Newport News Co.	1	3
				ARMORED CRUISERS.		
4	Pennsylvania	14,000	22	Cramp and Sons.	42	45
5	West Virginia	14,000	22	Newport News Co.	44	4b
6	California	14,000	22	Union Iron Works.	20	22
7	Colorado	13,600	22	Cramp and Sons.	46	48
8	Maryland	13,600	22	Newport News Co.	43	44
9	South Dakota	13,600	22	Union Iron Works.	22	24
10	Tennessee	14,500	22	Cramp and Sons.	0	0
11	Washington	14,500	22	New York S. B. Co.	0	0
				PROTECTED CRUISERS.		
14	Denver	3,100	17	Neafie & Levy.	86	86
15	Des Moines	3,100	17	Fore River S. & E. Co.	79	80
16	Chattanooga	3,100	17	Lewis Nixon.	68	68
17	Galveston	3,100	17	Wm. R. Trigg Co.	66	66
18	Tacoma	3,100	17	Union Iron Works.	64	66
19	Cleveland	3,100	17	Bath Iron Works.	91	92
20	St. Louis.	9,600	22	Neafie & Levy.	14	14
21	Milwaukee	9,600	22	Union Iron Works.	10	12
22	Charleston	9,600	22	Newport News Co.	27	31
				MONITOR.		
9	Florida	3,214	12	Lewis Nixon.	97	98
				TORPEDO BOAT DESTROYERS.		
6	Hopkins	408	29	Harlan & Hollingsworth.	95	96
7	Hull	408	29	Harlan & Hollingsworth.	99	99
8	Lawrence	400	30	Fore River S. & E. Co.	99	99
9	MacDonough	400	30	Fore River S. & E. Co.	98	98
				TORPEDO BOATS.		
19	Stringham	340	30	Harlan & Hollingsworth.	98	98
20	Goldsborough	248	30	Wolff & Zwicker.	99	99
27	Blakely	165	26	Geo. Lawley & Son.	99	99
29	Nicholson	174	26	Lewis Nixon.	98	98
30	O'Brien	174	26	Lewis Nixon.	98	98
34	Tingey	165	26	Columbian Iron Works.	90	94
				SUBMARINE TORPEDO BOATS.		
1	Plunger	120	8	Lewis Nixon.	99	99
4	Grampus	120	8	Union Iron Works.	92	92
6	Pike	120	8	Union Iron Works.	88	89
7	Porpoise	120	8	Lewis Nixon.	99	99
8	Shark	120	8	Lewis Nixon.	98	99
				STEEL TUGS.		
8	Pentucket	....	12	Navy Yard, Boston.	10	33
9	....	....	12	Navy Yard, Mare Island.	0	0

Since the last PROCEEDINGS was issued the monitor Nevada has been commissioned.

The Navy Bill for the fiscal year ending June 30, 1904, authorizes the following additional vessels: 3 battleships of 16,000 tons; 2 battleships of 13,000 tons; 2 steel ships and 1 wooden brig for training purposes. The 16,000-ton battleships will be named the Vermont, Kansas, and Minnesota, and will be on the same plans as the Louisiana and Connecticut; the plans of the 13,000-ton battleships are not yet decided upon.

ORDNANCE AND GUNNERY.

THE GUN-POWER OF BATTLESHIPS.—While it is always admitted that in the design of warships there must necessarily be many compromises, so as to secure the highest possible degree of efficiency from each of the several elements which go to make up the fighting power of the ship, it must be conceded generally that, in the case of a line-of-battleship, gun-power should take first place. In saying this, of course, we do not forget that, to live in order to fight, the ship must have a satisfactory degree of protection against the attack of the enemy. In some of what may be termed the secondary naval Powers there is, however, a very strong tendency to make protection somewhat subservient to speed, the idea being that as the financial resources are limited, and as, therefore, all the best qualities cannot be included in the highest degree, it is more important to be able to choose the time to fight, and therefore to be able to run away from a more powerful opponent, when prudence suggests this course. Such high-speed ships, of course, have a large degree of gun-power, so that they may, when there is a chance of success, engage in combat the enemy's ships in detail. This policy, however, so far as a first-class Power is concerned, is not admissible, for the simple reason that to terminate the state of war a decisive engagement must be fought; so that it is absolutely necessary that a first-class sea Power should have strong armament in all its ships, as well as complete defence, and, as far as possible, high speed.

It can scarcely be claimed that in our recent ships the offensive qualities have excelled to the same extent as in some other navies. There is, no doubt, compensation in other elements in design, each important in itself, but so far as the line-of-battleship is concerned, of less moment, in the view of many experienced naval critics, than the armament. Because of this, the battleship which is to be launched next Thursday by Messrs. Vickers, Sons, and Maxim, Limited, for the Chilian Navy, is of special interest, because on dimensions limited to suit the harbors of South America, she has powers of attack which are undoubtedly remarkable. If the standard of comparison be the weight of shot comprised in one round from the primary guns per unit of displacement, which enables all sizes of battleships to be taken into account, it is found that the ratio of this new ship is only exceeded by the latest vessels for the United States Navy, the battleships of the New Jersey class, of 15,000 tons displacement. The weight of shot which these American ships will be able to discharge per 1000 tons of displacement is 440 lb., whereas the weight fired in one round by this relatively small Chilian ship is 427 lb. per 1000 tons from all guns and 407 lb. from primary weapons. The nearest approach to this result is attained by the new Italian battleships, in which the speed aimed at is 20 knots. In these ships, the primary gun-fire is equal to 405 lb. per 1000 tons of displacement. In the 22-knot Italian ships, however, the proportion is 350 lb. The new battleships for the British Navy of the King Edward VII class marked some advance in this respect from previous vessels of our navy, as their guns of the first order fire at the rate of 362 lb. per unit of displacement. We are, of course, ready to admit that in other qualities, notably in their power to keep the sea for long periods,

these British ships have some advantage over the others named; and it must be noted that for a fleet whose principal business it is to "watch a port"—the new substitute for the old system of blockading—such qualities as coal capacity, etc., are of great consequence. In the Duncan class, of 19 knots' speed, the gun-power is equal to 328 lb. per 1000 tons displacement. In the latest French ships the proportion is 306 lb. per 1000 tons, and in the case of the Russian and German ships 290 lb. each.

This method of comparison, however, while it is based on the correct assumption that the British Navy does not possess any superior wealth in *personnel*, may not be quite satisfactory, as it takes no cognizance of the mechanical point of view. The strength of guns to enable high ballistics to be attained, the quality of explosive compounds and its influence on velocities, the form of the breech mechanism and its effect on rapidity of fire, as well as the design of the mounting—which has an important bearing on the speed of training and accuracy of aim—are all elements contributing to the efficiency of guns firing the same weight of projectile. Even if we assume that the mechanical features of the guns fitted to British ships are superior to those in foreign navies—and we fear that the freer hand given to British, as to other, firms by foreign clients scarcely bears out this assumption—there is the important fact that the explosive compounds used thus far in our ships give a velocity of 10 per cent less than that used by most of the European and American Powers, with an even greater rate of reduction in muzzle energy.

We have set out in the table on page 285 the dimensions of this new Chilian ship in comparison with several others of approximately the same size, with the view of showing the armament, the principal protection, and the speed given for the displacement tonnage allowed. It is difficult to find a ship of exactly the same type as the new Chilian boat from amongst the later British and French battleships, and therefore we have taken the Russell as a type representative of the British Navy; but the new vessels of the Patrie class are much too large for comparison. It will be noted that most of the ships are of 19 knots' speed, with the exception of the Italian vessel, in which a maximum of 22 knots is aimed at, at the expense alike of protection and gun-power. Italy has always strongly advocated high speed in her battleships.

It is not easy, without reproducing detailed drawings, to afford a clear and just comparison of the extent of armor protection, as the area protected may vary very considerably; and this is probably the case in the Russell. It will be noted that several of the battleships have a maximum of 9-inch armor on the broadside; but this may only be of limited extent. In the Chilian ship, on the other hand, the 7-inch armor is of the full depth of the citadel, extending from some 5 feet below the water-line to the level of the upper deck, while it is carried to the extreme ends of the ship as a water-line belt, tapering to 3 inches at the extremities. The armor citadel formed by this main armor-plating is about 280 feet long, with 'thwartship armored bulkheads at the ends. Within these latter are built the barbettes for the 10-inch breechloading guns. Two such weapons are mounted in each barbette, the walls of which are of 10-inch armor. On the main deck there are ten 7.5-inch guns, which are completely protected by the 7-inch armor broadside walls, and they are separated from each other by armored longitudinal bulkheads and traverses. Four more 7.5-inch guns are mounted on the upper deck, and these are placed within casemates having 7-inch armor. The conning-tower has 11-inch armor, and in addition there is a complete protective deck from end to end, varying in thickness from 1½ inches to 3 inches, while the upper deck itself is armored over the positions occupied by the 7.5-inch guns below. It will thus be recognized that this Chilian ship is very fully protected against the attack of any ship, even of the first importance.

We have indicated that there are four 10-inch guns and fourteen 7.5-inch guns, and as in these the Vickers' Company have embodied many important improvements, alike in the breech mechanism and mounting, a very high energy and rapidity of fire are obtained. Each of the 10-inch guns, which fire 500-lb. projectiles, will easily attain a rapidity of four rounds per minute, and with nitro-cellulose powder will develop an energy of over 27,960 foot-tons. The most remarkable change, however, is in the use of the 7.5-inch quick-firing guns, instead of the 6-inch weapon hitherto very largely used in similar cases. The difference is most marked, not only in the energy of each gun, but particularly in the destruction which may be done in a short period of time. In addition to those primary guns, the Chilian ship is specially strong in the auxiliary armament destined to meet attack by torpedo craft; and here one can easily recognize the influence of recent experience by the Chilian Navy Department. There are fourteen guns of the new 14-pounder type, which give a very high rapidity of fire; there are also two 12-pounders, for landing duty, four 6-pounders, four pom-poms, and four Maxims. The total weight of one minute's fire is 13½ tons. Taking the primary guns only, the minute's fire is:

	lb.		lb.		Foot-Tons in Energy.
12 projectiles of	500	=	6,000	and	335,568
98 projectiles of	200	=	19,600	and	1,186,584
110			25,600		1,522,152

From each broadside there may be fired per minute 12 projectiles of 500 lb., and 49 of 200 lb.—a total of 15,800 lb., with an energy of about 928,800 foot-tons. When chasing the enemy this Chilian ship can fire ahead each minute six projectiles of 500 lb., and 56 of 200 lb.; in all 14,200 lb., with a collective energy of about 845,900 foot-tons. This ship has also an immense gun-power against torpedo or submarine boat attack. Her smaller guns fire per minute 280 projectiles of 14 lb., 112 of 6 lb., 1200 of 1 lb. (pom-poms), and 2000 rifle bullets, so that the enemy, once discovered, would have little chance of escape.

We have worked out in the appended table the approximate weight of projectiles which may be fired per minute by the Chilian ship, as compared with representative ships of the same size belonging to other Powers, and it will be seen that the weight of shot is enormously greater in the new ship, being 13½ tons, while the 14,000-ton Russell fires 8.9 tons; the Russian Orel, of 13,600 tons, can fire 9 tons; the Austro-Hungarian ship, of 10,600 tons, 8.8 tons; the latest German ship, of 13,200 tons, 7.75 tons; and the Italian ship, of 12,624 tons, 8.7 tons of projectiles. Taking the collective energy of one minute's firing the Chilian ship develops more than double that of any of the ships we have named, with the single exception of the British battleship Russell. The Chilian ship, of 11,800 tons, has a collective energy per minute of 1,705,249 foot-tons, while the Russell, of 14,000 tons, has an energy of 984,365 foot-tons. It is, however, pretty well accepted that the next naval engagement will be fought at a very long range—probably 3000 yards—so that the figures we give on the table, showing the approximate striking energy developed per minute in the Chilian ship and others in the list at this range, are interesting. Here, again, it will be seen that the collective total for a minute is more than double that of any of the ships on the list, notwithstanding that she is the second smallest in the comparison. Of course, the 10-inch guns separately are not equal to the 12-inch weapons fitted to one or two of the ships; but in view of their power, especially when capped shell is used, there can be no doubt that they will do destructive work, and their choice is a wise compromise, especially as it enables fourteen of the new 7.5-inch guns to be fitted on board. Each 500-lb.

TABLE OF PARTICULARS OF MODERATE SIZED BATTLESHIPS.

	Chilian Ship.	H. M. S. Russell.	Austria-Hungary: Ersatz Laudon.	German: Latest Ships.	Italian: Vittorio Emanuele III.	Russia: Orel.
Length (between perpendiculars)	436 ft.	405 ft.	390 ft.	398 ft. 6 in.	435 ft. 6 in.	376 ft. 5 in.
Breadth	71 ft.	75 ft.	72 ft. 3 in.	72 ft. 10 in.	73 ft. 6 in.	76 ft.
Draft	24 ft. 7½ in.	26 ft. 6 in.	24 ft. 6 in.	24 ft. 10 in.	27 ft. 3 in.	26 ft.
Displacement	11,800 tons.	14,000 tons	10,600 tons	13,200 tons	12,624 tons	13,600 tons
Indicated horsepower	12,500	18,000	14,000	16,000	20,000	16,000
Speed	19 knots.	19 knots.	19 knots.	19 knots.	22 knots	18 knots
Armor belt	7-in.—6-in.	7-in.	8¼-in.—5-in.	9-in.—4-in.	9¾-in.	9-in.—4-in.
" gun positions	10-in.—7-in.	11-in.—6-in.	9-in.—4-in.	10-in.—6-in.	8-in.	6-in.
Armament	4 10-in.	4 12-in.	4 9.4-in.	4 11-in.	2 12-in.	4 12-in.
	14 7.5-in.	12 6-in.	8 7.5-in.	12 6.7-in.	12 8-in.	12 6-in.
	14 14-pdrs.	12 12-pdrs.	6 6-in.	12 1.4-in.	12 3-in.	20 3-in.
	2 12-pdrs.	6 3-pdrs.	28 smaller.	8 Maxims	12 1.8-in.	20 3-pdrs.
	4 6-pdrs.					6 1-pdrs.
	4 1-pdrs.					
	(pom-poms					
	4 Maxims					
Approximate weight of projectiles per minute	13.5 tons	8.9 tons.	8.8 tons	7.75 tons.	8.7 tons	9 tons.
Approximate collective muzzle energy	1,705,249 ft.-tons	984,365 ft.-tons	704,042 ft.-tons.	843,578 ft.-tons.	643,861 ft.-tons.	784,295 ft.-tons.
Approximate energy at 3000 yards range	850,243 "	322,596 "	376,203 "	460,658 "	275,899 "	307,868 "

capped shot may perforate at half-a-mile range the broadside armor of any ship afloat; while the 200-lb. shots may perforate 6-inch armor at 1000 yards range.

These splendid fighting qualities, too, have been provided upon limited dimensions—the length being 436 feet, the beam 71 feet, and the draft only 24 feet 7½ inches. The displacement is 11,800 tons. A sea speed of 19 knots is to be realized. The two engines, driving separate propellers, will develop 12,500 indicated horsepower. Nor have this high speed and fighting power been attained at the sacrifice of radius of action, as the ship carries fuel and supplies to enable it to steam at 10 knots for 11,000 sea miles.—*Engineering*, January 9, 1903.

Messrs. Armstrong and Messrs. Vickers Maxim have built the two Chilian battleships Constitucion and Libertad partly in competition, and they were launched respectively at Elswick and Barrow within two days of one another, the Constitucion on January 13 and the Libertad on January 15. They are sister ships of very remarkable qualities, displacing about 11,800 tons, and possessing protection and, above all, gun-power superior to nearly every ship afloat or in course of construction. The problem to be solved was to combine high gun-power with special protection and great speed in ships of moderate draft, capable of operating in shallow waters, and yet with particular properties to ensure a steady gun platform in heavy seas such as would be experienced off Cape Horn or in the Southern Pacific. Lieut. A. T. Dawson, at the launch of the Libertad, said that the four 10-inch guns of the ships would have a muzzle velocity of 2840 foot-seconds, and would be capable of perforating at a range of three miles the 11-inch Krupp cemented plates on the American battleships of the Louisiana class. The fourteen 7.5-inch guns, with a muzzle velocity of 2955 foot-seconds, could penetrate at a range of four miles the 5-inch Krupp plates of the latest American cruiser of the Tennessee class. In one single round the ships can discharge projectiles at the rate of 427 lb. for each 1000 tons of displacement, and 407 lb. from the primary armament only. Judged in this way they are a long way ahead of any battleship afloat, except the recent vessels of the New Jersey class. The protection consists of an armored belt 8 feet deep, extending almost from end to end, with a transverse bulkhead aft almost 3 inches thick. This belt is 7 inches thick in wake of the engines and boilers, tapering to 3 inches at the end. Amidships is a citadel, also with 7-inch armor, rising to the upper deck, in which are ten of the 7.5-inch guns separated by 1-inch bulkheads. There are thus no casemates, except for the four remaining guns of the class on the upper deck. The barbettes for the big guns have 10-inch armor in front and 8-inch in the rear. The protective deck varies from 3-inch to 1½-inch, while the conning-tower has 11-inch armor. Engines of 13,000 horsepower, supplied by Yarrow large-tube boilers, are expected to give a speed of nineteen knots. The coal capacity will be about 2000 tons.

The following results, publication of which has been authorized by Admiral Simpson, of the Chilian Navy, are interesting as showing the effect of capped projectiles; they were obtained at the proof of a 7-inch armor-plate, manufactured and tested by Messrs. Vickers, Sons, and Maxim, Ltd., as a sample of the armor of the Chilian battleship Libertad, recently launched at Barrow-in-Furness:—Four rounds were fired at the plate from a 6-inch gun with 100 lb. standard projectiles, having striking velocities of 2110, 2124, 2104, and 2104 feet per second; all of these the plate withstood, the only effect being slight damage to the face, but no cracks whatever showing on the plate. It was then decided to test the effect of a standard shot fitted with the Johnson cap against the same plate. This was fired to give a striking velocity of 2116 feet per second, and completely perforated the plate, backing, and skin plate. The pro-

jectile, however, was broken up in passing through the plate, and a piece of plate about 6 inches in diameter was punched through the backing and skin plate, and was picked up 38 feet in rear. A trial was next made against the same plate of a 7½-inch armor-piercing shell, fitted with a Johnson cap, the shell containing a bursting charge of 6 lb. and weighing 200 lb. A striking velocity of 2107 feet per second being given to the shell, it completely perforated the plate, backing, and skin plate, taking with it a disc of the plate about 7½ inches in diameter, which, after passing through the sand buttress, was picked up some 300 yards in rear.—*United Service Gazette*, February 14, 1903.

A NEW SYSTEM OF GUN SIGHTING.—Captain Hubert Grenfell, R. N., has invented a device, the object of which is the reduction to a minimum of the duty demanded of the gunner. With this device the gunner has simply to fire the gun at the instant his sights come in a line with the target, a second man having meantime corrected the aiming for range. This invention is especially adapted to naval ordnance, where accuracy in firing is much more difficult to obtain than with land artillery, on account of the great mobility of the ship carrying the gun and of the targets, and also because the range at sea is constantly changing. Two fleets which mean to fight will probably first approach each other at a high speed; this means that the gunners will have to deal with a continuous alteration of range due to a total approaching speed of, at least, 30 knots. Two ships advancing towards each other at this rate diminish their distance apart by over 100 yards every six seconds. In order to secure accurate firing under such conditions, a constant alteration is required in the axis of the gun; the movement required being therefore practically continuous, it is absolutely necessary to entrust the duty of correcting the aim for range to a man who is not immediately concerned with the firing of the gun. It is also essential that the correct range be clearly transmitted and displayed each moment at every gun position. All artillerists—and chiefly, perhaps, those who have given special attention to land artillery—are clearly of opinion that, given two opposing batteries of approximately equal value. the one able to fire in a minimum time the largest number of rounds is practically sure to silence its opponent. The French artillerists eagerly adopted the sighting device with independent rear-sight, as a means to secure the desired end with greater rapidity and a higher degree of accuracy. In naval encounters the object will evidently be similar, and the successful fleet will in all probability be the one that is able to ensure a maximum use of its ordnance within the first few minutes after the opening of an action. In the Grenfell sighting gear fitted to a 6-inch gun on board H. M. S. Narcissus, tender to the Portsmouth Gunnery School, fully described and illustrated in the last issue of *Engineering*, the device consists of a series of differential gearing actuated by two hand-wheels, one of which is held by the firer while his eye remains on the sight, the other wheel being worked for correcting the aim for range by another number, called the sight-setter. The gearing acts as follows: The firer, by operating his wheel, aligns the sight and the axis of the gun simultaneously on the target. The sight-setter at the same time alters the axis of the gun in relation to the line of sight; or, in other words, he increases or decreases the elevation of the gun for range without altering or disturbing the line of sight in any way. The axis of the gun is turned in relation to the sight, instead of turning the sight in relation to the axis of the gun, and then moving the axis of the gun to re-align the sight, as in present practice. Both these operations can be carried out simultaneously or independently of each other, neither interfering with the result required by each operator. If one only of the hand-wheels be turned, the axis of the gun fully answers the single action with regard to the sight. When, however, the two hand-wheels are operated together, the gun axis answers the double action in a measure

exactly equal, according to direction, to the difference between, or the aggregate of, the motions due to the double action. The resulting position for the gun axis, in the latter case, is exactly that which would be taken up were the two hand-wheels to be worked in succession, to the same extent, instead of simultaneously. The result desired by the firer is the alignment of the gun axis laterally, and in elevation, to insure hitting the target; and this is insured when the range is known and the sight adjusted for that range, by bringing the sight upon the target (and with it the axis of the gun) at a constant angle with this line. The duty of the sight-setter is the exact adjustment of the angle between the axis of the gun and the line of sight, or, as already stated, the correcting of the aim for range. The firer can therefore keep his eye constantly along the sight, and by working his hand-wheel and bringing the line of sight on the target he lays the gun correctly, while the setter is continuously altering the elevation for range without disturbing in any way the line of sight. The attention of the firer is concentrated upon the sole duty of discharging the gun at the very instant his sight-line is on the target. The rapidity and accuracy of firing are greatly increased thereby.—*United Service Gazette.*

Mr. Arnold-Forster, replying to Mr. Yerburgh, in the House of Commons, said he was aware that in the "Notes of Naval Progress," published in July at the Government printing office in Washington, it was stated that the return of the annual prize firing with heavy guns by the Channel Fleet was published, and that the results of the competition were given. The same return had also been published in the press of this country, but the particulars both with regard to the Channel and other squadrons were not for sale as ordinary papers, but were regarded by the Admiralty as being for the information of the officers of the navy, and it was not considered desirable to publish them in the form of a return. Mr. Yerburgh asked why these particular figures should be accessible to foreign powers and not to members of the House of Commons. Mr. Arnold-Forster regarded it as unfortunate that they should be accessible when the figures relating to foreign countries were in no case accessible to us, and he thought it desirable that steps should be taken to prevent the publication of our figures in future. Replying to a further question on the same subject, the Secretary to the Admiralty said the results of the prize firing in 1901 brought to the attention of the Admiralty did not agree with figures quoted by Mr. Yerburgh to the effect that forty-six ships did not fire at all, among them being two admirals' ships, the Revenge and the Royal Arthur; that of the one hundred and twenty-seven ships that took part in the firing, while one ship made over 70 per cent of hits, and two ships made over 65 per cent of hits, seventy-five ships missed the target eighty-five times out of every hundred rounds, that five ships never hit the target at all, and that one admiral's ship, the Warspite, was last of its squadron.—*United Service Gazette.*

The Admiralty have completed a series of experiments which now leaves no doubt that the ammunition manufactured during the period between June, 1899, and November, 1901, for use with 6-pounder and 3-pounder quick-firing guns is defective, and as there is a large quantity of it now in the service, their lordships have ordered that it is to be immediately returned to store.—*United Service Gazette.*

At the bombardment of Puerta Capella, it was noted that the British guns fired much more rapidly than the German. By the "rate of fire" tables, the German pieces can do about two shots to the British one!—*Engineer.*

Interesting trials are about to be made at Kiel with the Italian Engineer Pino's hydroscope, by means of which one can see to a great depth in the sea. It can be used from a ship's bridge, making submarines, torpedoes, cables, etc., visible. Successful tests have already been made with this instrument in Italy.—*Le Yacht.*

Further experiments were carried out at Bembridge Ledge, off the Isle of Wight, on the hulk Belleisle on Tuesday, in the presence of a large number of naval officers and admiralty officials. The experiments were directed by Captain A. Barrow and the staff of the Excellent gunnery school. The principal object of the test was to discover how far armored gratings and splinter nets afford protection to the men working below when in action. On the upper deck a large steel screen ½ inch thick had been erected, and in front of this there had been inserted on the upper deck a 20-foot square of armored grating. Between this and the main deck there was a splinter net, and below this, again, the open engine room. The object of the screen was to either break up the shells or to hold the *débris*. The attacking vessels consisted of the gunboats Kite and Pincher, from which Lyddite and common shells were fired from 6-inch and 9.2-inch guns. The action of the Lyddite shells was somewhat diffuse, while the common shells exploded more locally. After each round the effect of the experiment was examined by the officers in charge of the trials, and at the close of the experiments the Belleisle was towed back to Portsmouth, where a strict guard was placed to prevent unauthorized persons from going on board. Although no definite arrangements have been made, it is understood that the Belleisle will next be subjected to a series of torpedo attacks.

TORPEDOES.

The *Morning Advertiser* has announced that the scientific staff of the Vernon have produced a new torpedo which is at present the monopoly of the British Navy. The new weapon is a formidable engine of war, capable of a speed of some 34 knots and a range of 3000 yards. It will, says our contemporary, be part of the armament of the new battleships and cruisers now under construction. The newest type of torpedo at present in use in the navy is a Whitehead automobile which has a speed of 32 knots and a range of 2000 yards.

THE NEW TORPEDO.—That the torpedo would stand still even those opposed to it would never have argued, while enthusiastic believers in it, like Major-General Crease, have continually prophesied its development. Just at present the laugh is certainly in the side of these last, for we understand that the British Navy is now in possession of a very rapid torpedo with a range of no less than three thousand yards. It seems only yesterday that one thousand yards was the recognized limit of the torpedo zone. Then came the gyroscope, which, by affording an automatic means of steering, rendered it possible to double this range. Over two thousand remained impossible, because the torpedo that would do more than drift beyond that range was not in existence. Now, by the process of mechanical progress, a thousand yards more range has been secured, and there is no visible reason why even this distance of a mile and a half should not be exceeded.

What accuracy will be secured at such distances we cannot say, but since at two thousand very fair shooting is made, there seems little reason to anticipate wild shooting at three thousand. There is not with the torpedo that delicate question of elevation which forms the crux of gun-

nery. With the gyroscope, provided a torpedo be truly aimed, it is not so very material whether the range be four hundred or sixteen hundred yards. The only x factor is the speed of the enemy. The speed of the ship firing is gauged on the director, on which is set also the estimated speed of the enemy. If that speed be correctly guessed, then the target might as well be at rest as moving. An error of a knot will not greatly signify, and—if the enemy be a fleet—it is known that the probable speed will be about 12 knots. Ships dare not attempt to keep station in action at much over that speed; at much under they would risk sacrificing too much.

Now, at three thousand yards, supposing the torpedo to take three minutes *en route*, a fleet doing 12 knots moves twelve hundred yards—a hundred yards for each knot. Each hostile ship is well over a hundred yards in length if broadside on, and there are spaces between the ships of from three to four hundred yards. The target, in other words, consists of one part ship and three parts gap—that is the essentially simple way of looking at the matter. There is, at three thousand yards, a margin for error of about one knot in speed. A torpedo aimed at the bow of a ship supposed to be doing 11 knots, but actually doing 12 knots, stands a fair chance of hitting that ship aft. At two thousand yards, a two minutes' torpedo travel, the margin is about two knots, or a knot either side of the estimated speed of the enemy. So far so good; hitting appears far more probable at two thousand than at three thousand yards. It is more probable. But at three thousand there is considerably more chance that, supposing a miss, the ship astern of the one fired at may have come up in the path of the torpedo; and, supposing the weapon to be discharged at a fleet as a body—a very big target—there is a 25 per cent chance of hitting something. At two thousand yards there is considerably less chance that a shot "into the brown," missing one particular vessel, will hit another. This matter is already sufficiently recognized to the extent that two thousand yards is in all navies the nearest battle range, and the hope of seriously damaging an enemy by penetration thus far discounted. The new torpedo is likely to make the range limit three thousand yards, a distance at which very little penetration may be hoped for. Even were normal impact to be secured, thick armor will defeat most blows at three thousand. The torpedo, therefore, is making a very serious bid for direct rivalry with the gun.

It is not likely, however, that the gun will idly see this rival defeat it. Other things apart, there is too much capital invested in guns and armor and the great ships that carry them. We confidently look, therefore, to see an early advance over even the best present-day gun models. Velocities, which have lately risen to nearly three thousand foot-seconds, are likely to be driven still further, and more advances made towards the ideal guns whose trajectory shall be comparatively flat at all possible ranges. Nothing, already, is of so great value to a gun as the flat trajectory, and this apart from the incidental advantages that such a trajectory implies. A flattening of the trajectory means increased velocity and increased penetration, but greater than these is the increased chance of hitting through the enlargement of the danger space. Increased certainty of hits at long bowls is therefore to be anticipated as a corollary to the new torpedo.

There is, however, another point of view. A torpedo boat at night is barely visible at two thousand yards, at three thousand she is almost certain to be unseen. If seen she runs no appreciable risk of being hit. How, then, will a fleet fare at night? Certainly there is a problem here, and one that will take endless thinking about till the solution is found—for some solution must exist. So far, we understand, the new torpedo is a monopoly of the British Navy. That every possible enemy will be, or already is, endeavoring to secure the secret goes, however, without

saying, and probably ere long they will succeed in doing so. It can hardly be otherwise. This being so, we may expect to see three thousand yard torpedoes a regular feature of the equipment of all warships in the course of a couple of years or so, and "cheap" as the expression, "a revolution in naval warfare," has now become, something very like it seems to be within the sphere of possibilities. Were submarines of any real utility, were they able to do half of what is claimed for them, the new torpedo, which at night can be discharged before the firer is seen would heavily discount them. Perhaps the best estimate of the new invention is that it does above water all that may reasonably be hoped for from submarines.—*Engineer,* December 26, 1902.

Hitherto torpedo practice in the navy has been confined to the firing of Whitehead torpedoes which have been fitted with dummy heads, in place of the ordinary war service heads, each of which is charged with about 200 lb. of guncotton. The object has been to recover the torpedoes after the completion of the practice; and as the cost of a torpedo only a few years ago was £500, their recovery has been a matter of great consideration. Now, however, we learn from the *Western Morning News,* that the Admiralty have decided to make the torpedo firing practice more of a reality by approving of a certain number of "live" torpedoes being fired annually on the China, Mediterranean, and home stations. The torpedoes will be given trial runs with their dummy heads, and when sent off on their final run, with their heads fully charged, they will be adjusted to "float" should they fail to strike the target, so that the cause of failure may be ascertained.—*Engineer,* January 9, 1903.

The Admiralty have always carefully preserved the secrecy of the manufacture of submerged torpedo tubes and the equipment of a submerged torpedo room. When, however, it was recently decided to have war vessels entirely refitted at private dockyards, it was found necessary to take special precautions to prevent these secrets from leaking out. All work in connection with submerged tubes will be carried out by a special staff of mechanics from the dockyards, and during the time they are employed on the work the contractors' workmen are on no account to be allowed in the compartments. At every Government dockyard there is a special staff of engine fitters employed on torpedo work only, and each man is sworn not to divulge the secrets with which he is entrusted.—*United Service Gazette.*

BOILERS.

A "Return showing comparison between ships with Scotch boilers and those fitted with water-tube boilers," in continuation of Parliamentary paper No. 356, has been issued as a Parliamentary paper (405). The cost of upkeep of the ordinary Scotch boiler is shown to be comparatively small, while that of the Belleville threatens to become a serious item in the country's naval expenditure. The Diadem class of seven cruisers of 11,000 tons and 16,500 indicated horsepower has proved most expensive, as the following figures of the expenditure on alterations, additions, and repairs since their first commissioning show:

Ship.	In Commission.	Engines.	Boilers.
Diadem	3 yrs. 7 months	£5,953	£14,515
Andromeda	2 yrs. 9 months	2,153	4,327
Niobe	3 yrs. 6 months	2,974	7,048
Europa	1 year	8,676	26,935
Amphitrite	10 months	1,951	4,095
Argonaut	2 yrs. 2 months	2,664	3,716
Ariadne	3 months	1,382	2,701

Other ships have also proved costly, the little cruiser Pelorus requiring £13,136 in just over five years, her sisters the Prometheus, £2947 in ten months, and the Pioneer £4242 in twenty months. On the engines and boilers of the Hyacinth, of 5600 tons and 10,000 horsepower, £9949 has been spent in twenty-one months, and, including new boilers, her sister, the Hermes, in fourteen months, has swallowed up no less than £44,048. The battleship Canopus, which is returning to England owing to defects, has already cost for engine and boiler work £4637 in two and a half years, while in three years the Powerful has needed £29,904, of which nearly £18,000 has been due merely to repairs of the boilers only in a period of three years.—*United Service Gazette,* January 10, 1903.

JOINT EQUIPMENTS OF CYLINDRICAL AND WATER-TUBE BOILERS FOR BRITISH CRUISERS.—The decision of the British Admiralty to fit joint instalments of cylindrical and water-tube boilers into each of the six new Devonshire class of cruisers is a new departure in the British Navy. Hitherto each vessel has been fitted throughout with one type of boiler. Either they have been all cylindrical, all Belleville, or all of some other type of water-tube boiler. Now, however, it is proposed, or rather resolved, to fit boilers into the ships to suit both cruising speeds and high speeds.

For these particular cruisers the cruising speed, or easy rate, at which they may make ordinary voyages, lies between 12 and 13 knots, and it is intended to fit a sufficient number of cylindrical boilers into the ships to give them steam enough to make this speed. But in time of war it is intended that these ships should make higher speeds, reaching up to a maximum of 23 knots an hour, and accordingly the Admiralty have decided to fit them with water-tube boilers of capacity enough to supply the necessary steam to make the speed above the cruising rate when it is desired. The cylindrical boilers will thus always be at work. The water-tube boilers will be in action only when the exigencies of war require the higher speed to be made.

The final decision of the Admiralty is that of the total maximum 22,000 horsepower in each ship, 4500 horsepower are to be provided by cylindrical boilers for cruising purposes, and the remainder by water-tube boilers for the higher speeds.

Four types of water-tube boilers are to be fitted into the six cruisers. Two ships will be fitted with Yarrow boilers, two with Niclausse, one with Dürr, and the sixth with Babcock & Wilcox boilers.—*Cassier's Magazine* for January.

The Chilean ships Constitucion and Libertad are fitted with Yarrow boilers of large-tube type, there being twelve boilers in each ship, placed in groups of three, in separate water-tight compartments. In each of these stokeholds there is a feed-pump, fan, ash-ejector, and ash-hoist. The height of the two funnels is 90 feet above grate level, and the diameter is 10 feet 6 inches over the casings.

This type of boiler is being largely adopted. The Austrian Navy have now built, or have in course of construction, three battleships and four cruisers with Yarrow boilers aggregating 77,900 indicated horsepower. In the Dutch Navy there are three cruisers, each with three-fourths of the boiler installation of the Yarrow, and the remaining one-fourth of the cylindrical type, while three other cruisers and three coast-defence ironclads are entirely supplied with steam from boilers made by the Poplar firm, the total horsepower being 70,500 indicated horsepower. Two Norwegian battleships add 9000 indicated horsepower to the list, a Portuguese cruiser 12,500 indicated horsepower, and seven Sweden ships 39,000 indicated horsepower, so that foreign warships, excluding torpedo craft, represent a total of 233,900 indicated horsepower, to which there falls to be added 53,200 indicated horsepower for British warships, four-fifths of the steam

generators in the new cruisers Hampshire and Antrim being of this type, while all the boilers in the third-class cruisers Amethyst and Diamond are being made at Poplar.— *Engineering*, January 23, 1903.

WATER-TUBE BOILERS. FURTHER REPORT.—The expert committee appointed by the Admiralty on the subject of water-tube boilers, with Admiral Sir Compton Domvile as chairman, has issued a report as a Parliamentary Blue-book which covers the complete results of the trials, under the committee's direction, carried out on the torpedo gunboats Sheldrake and Seagull and the sloops Espiegle and Fantome. The Sheldrake and Espiegle are fitted with Babcock and Wilcox boilers and the Seagull and Fantome with Niclausse boilers. "The installations in these vessels," the committee observes, "are small, but as no other vessels in his Majesty's service are fitted with these boilers the committee thought it would be well to try them, though they realize that the results obtained in such small ships may not be repeated with larger installations." From the results of the trials the committee institutes a comparison between the two types of boilers. In the matter of the production of steam the committee points out that the power required was, on the whole, obtained more readily from the Babcock and Wilcox than from the Niclausse boilers. This was specially noticeable on the full-power trials of the Sheldrake and the Seagull, but it had to be remembered that the heating surface of the Sheldrake's boilers was 15 per cent greater than that of the Seagull's boilers. The trials were completed in each ship without any defects having been developed in the boilers themselves, but the series of trials in each of the vessels was so short that the boilers were not really tested as to their freedom from developing defects while being used even for comparatively brief periods on actual service.

It appears that in the sloops the Niclausse boilers gave wetter steam than the Babcock and Wilcox boilers. In this connection it is to be noticed that the steam-collector of each of the Babcock and Wilcox boilers of the Espiegle is 3 feet 6 inches internal diameter by 9 feet 6 inches long, while the steam-collector of each of the Niclausse boilers of the Fantome is 2 feet 7¼ inches internal diameter by 5 feet 11 inches long. Thus the area of water surface is about 130 square feet in the Espiegle, and about 60 square feet in the Fantome. Further, the steam space in the boilers of the Espiegle is about 2.7 times that in the Fantome. The boilers of the Fantome are fitted with small steam domes, but it does not appear that these were sufficient to compensate for the very great proportional reduction in water surface and steam space. The steam obtained from the Sheldrake's boilers showed about 4 per cent of wetness on each of the short trials, and it is noticed that the design of the boilers of that ship is such as to render the probability of wet steam being given off much greater than in the case of the latter boilers of the Fantome. Thus the Sheldrake's boilers have small generating tubes and only one return tube for each header, while the Espiegle's boilers have large generating tubes and two return tubes at each header, in addition to a baffle plate over the ends of the return tubes in the steam-collector. In the case of the Seagull the steam used during the 1000 H. P. trial was practically dry, but on the full-power trial it was noticed there was a wetness of over 3 per cent, and in her case also it is to be observed that the steam-collectors are small, being only 2 feet 7½ inches diameter. The installation of machinery fitted with the Niclausse boilers on every occasion showed less loss of feed water than the similar installation fitted with Babcock and Wilcox boilers. This was very noticeable on the coal-endurance trial of the Fantome, where the evaporators were not used throughout the trial, although on a similar trial of the Espiegle it had been necessary to use one evaporator for 14 out of the 90 hours of the trial. The inferior efficiency of the boilers of the sloops on the coal-endurance trials as compared with that found on the shorter trials, seems

to have been to a great extent due to the necessity for cleaning the fires. If the results obtained for the first eight hours, or even 16 hours, of each coal-endurance trial be examined by themselves, it will be seen that they gave figures very nearly the same as those obtained on short trials at about the same horsepower—that for the Espiegle being 1.88 and that for the Fantome 1.91 lb. of coal per horsepower hour for the first 16 hours respectively, as against 1.86 lb. in each ship on the short trials. The long trials of the gunboats do not, however, show any material difference in economy from the short trials, which may, perhaps, have been due to the stoppages in their trials from fog and other causes, which had practically the effect of converting the trials into a series of short ones. The boilers of the sloops were new in 1901, whereas those fitted in the torpedo gunboats were new in 1897. Comparing the efficiencies of the earlier and later Babcock and Wilcox boilers, the maximum efficiency of the boilers of the Espiegle reached 73.2 per cent as against 66 per cent in the Sheldrake, or an improvement of about 11 per cent, and the average efficiency in the Espiegle is 67.8 per cent as against 63.1 per cent in the Sheldrake, or an improvement of 7 per cent.

Turning now to the Niclausse boilers, the maximum efficiency in the case of the Fantome was 69.8 per cent, as against 66.9 per cent in the Seagull, showing an increase of about 4 per cent; and the average efficiency in the Fantome is 63.4 per cent, as against 63.2 per cent in the Seagull, or practically the same. The results with the Babcock and Wilcox boilers seem to show that the large tube boilers, as fitted in the Espiegle, are more efficient than the small tube type fitted in the Sheldrake. As the arrangement of heating surface is the same in both the earlier and later boilers of the Niclausse types, the comparative results obtained with the Seagull and Fantome are what might have been expected. The boilers of the Sheldrake are not fitted with furnace gas baffles. The baffles in the boilers of the Seagull are as originally fitted; they are similar to the modified baffles of the Fantome. In the boilers of the Espiegle two sets of vertical baffles are fitted which make the masses rise at the back of the furnaces among the back ends of the tubes, then fall again among the tubes about half way along their length, and rise again among the front ends of the uptakes. A similar arrangement was fitted in the Martello, but in this vessel these baffles have recently been removed and the area of outlet at the uptakes restricted, in consequence of the difficulty experienced in cleaning the boilers with the baffles in place. Experience on the long trials of the Espiegle and Fantome showed that the boiler feeding in these ships could be easily regulated by hand. This is a very distinct advantage possessed by Babcock and Wilcox and Niclausse boilers, although it is to be remembered that there are only four boilers in each of these installations. It will, however, no doubt be found that automatic feed regulation will be a valuable adjunct in similar boilers in large installations. The automatic feed regulators fitted in the Fantome worked throughout the trials in a satisfactory manner, without giving any trouble. Those fitted in the Espiegle were not so satisfactory, as they occasionally stuck and allowed the water in the boilers to fall below the proper working level before opening, or allowed too much water to enter the boilers before they closed. The feed regulators of the Sheldrake and of the Seagull call for no special remarks, but they required attention at times. The space occupied by the Niclausse boiler in the Fantome is considerably less than that occupied by the Babcock and Wilcox boilers of the same power in the Espiegle, although the grate surface and heating surface are nearly alike; but the results appear to indicate that this advantage has been obtained at the expense of some other advantages.

The boiler-room weights of the Sheldrake are about 8 per cent less than those of the Seagull, although the Sheldrake has 15 per cent more heating surface. This may probably be accounted for by the fact that the boiler tubes of the Sheldrake are small in diameter (1 13-16 inches),

thus giving a large heating surface for a small weight, and also by the fact that the Seagull has six boilers against four in the Sheldrake. In the case of the Espiegle and Fantome, however, the Babcock and Wilcox boilers are 25 per cent heavier than the Niclausse boilers. The fire grate and heating surface of the boilers of the Espiegle are slightly greater than those of the Fantome. The generating tubes in the boilers of both ships are of practically the same diameter, so that neither type of boiler has any advantage in obtaining a larger amount of heating surface on reduced weights by the use of smaller tubes. A large portion of the excess of weight is due to the fact that the steam collectors of the Espiegle are considerably larger than those of the Fantome, thus not only increasing the weight of the boilers themselves, but also of the water contained in them.—*United Service Gazette,* January 17, 1903.

The Hermes, whose breakdown some time ago led to her Bellevilles being used for scrap heap purposes and the like, has just emerged from Harland and Wolff's Belfast Yard re-boilered with twenty Babcock and Wilcox generators. This type of boiler has so far done better than any water-tube boiler we have yet tried in large vessels, save the Mumford boiler.—*Engineer,* February 27, 1903.

Boilers in the French Navy.—The unfortunate experience of the Jeanne d'Arc and other new vessels has at length convinced our French neighbors of the necessity of following the example of other nations in condemning small tubes in boilers upon all ships of a greater tonnage than torpedo boats. In a communication to the admirals and maritime prefects M. Camille Pelletan points out the inconveniences of this system of boiler, with its high consumption of fuel, and consequently diminished range of action, to say nothing of the superhuman work put upon the hands in the stokehold, and he announces that in all the new vessels boilers with larger tubes are to be fitted. He also insists upon the absurdity of putting vessels through their trials for short periods with the furnaces under forced draft, as this not only gives misleading results, but is certain to cause disappointment when the ship fails to steam at anything like this speed in actual practice. Consequently, the Minister has decided that in future each ship will be subjected to two trials, one of ten hours with all the furnaces alight under normal conditions, and another of three hours with only three-fourths of the furnaces at work under forced draft.—*Engineer,* February 20, 1903.

STEAM TRIALS.

TRIALS OF TORPEDO-BOAT DESTROYERS DURING THE YEAR 1902.

Name of Shipbuilder and Engineer.	Name of Vessel.	Approximate Displacement.	Type of Boiler.	Grate Area.	Tube Surface.	Indicated Horsepower.	Speed in Knots.	Pounds of Coal per I. H. P. per Hour.
				sq. ft.	sq. ft.			
John Brown and Co	Arab	415	Clydebank Normand	296	16,080	(a) 8792	30.89	2.455
						(b) 8903	30.79	—
Doxford..........	Success	345	Thornycroft	225	13,520	(a) 6607	30.02	2.62
						(b) 6656	30.22	—

(a) Three-hours' full-power coal consumption trial. (b) Three-hours' full speed trial.

N. B.—No torpedo-boats completed their official trials during the year.

—*Engineering.*

RESULTS OF OFFICIAL STEAM TRIALS MADE DURING 1902.

Name of Ship.	Type.	Builders of ship.	Makers of Machinery	Length of Ship in Feet.	Displacement.	Type of Boiler.	Heating Surface.	Grate Area.	30 Hours' Coal Consumption Trial. Indicated Horse-power.	Speed.	Coal per hour per Indicated horsepower.	30 Hrs. Coal Consumption Trial at Higher Power. Indicated Horse-power.	Speed.	Coal per Hour per Indicated Horsepower.	Full Power Trial. Indicated Horse-power.	Speed.	Coal per Hour per Indicated Horsepower.
					tons		sq. ft.	sq. ft.		knots.	lb.		knots	lb.		knots.	lb.
London ...	Battleship	Portsmouth Yard	Earle's Shipbuilding Company	400	15,000	Belleville	37,078	1183	3247	11.5 (log)	1.8	11,753	16.4 (log)	1.8	15,299	18.0 (log)	1.97
Venerable.	Ditto	Chatham Yard	Maudslay, Son, and Field	400	15,000	Ditto	37,074	1202	3082	11.45 "	2.015	11,364	16.8 "	1.95	15,367	18.3 "	2.14
Duncan....	Ditto	Thames Engineering Company	Thames Iron Works	405	14,000	Ditto	43,260	1380	3755	11.9 "	2.05	13,717	18.1 "	1.90	18,222	18.9 "	1.95
Russell	Ditto	Palmers Shipbuilding Company	Palmers Company	405	14,000	Ditto	43,260	1393	3767	12.1 "	2.4	13,685	17.95 "	2.14	18,199	19.4 "	2.10
Montagu...	Ditto	Devonport Yard	Laird Brothers	405	14,000	Ditto	43,405	1400	3676*	12.0 "	2.21	13,652*	17.80 "	1.78	—	—	—
...outh ..	Ditto	Laird Brothers	Ditto	405	14,000	Ditto	43,260	1393	3667	12.4 "	2.18	13,774	17.7 " 17.928 m.m.	1.95	18,285	18.8 " 19.015 m.m.	2.117 —
...Tope	First-class cruiser	Fairfield Company	Fairfield Company	500	14,100	Ditto	71,970	2310	6074	14.5 "	1.86	22,761	22.09 m. m.	1.83	31,119	23.05 m.m.	1.91
...red	Ditto	Vickers, Sons, and Maxim	Vickers, Sons, and Maxim	500	14,100	Ditto	72,003	2313	6419	15.6 "	1.75	22,616	21.7 (log)	1.82	30,950	23.65 (log)	1.81
....	Ditto	Pembroke	Humphrys, Tennant, and Co.	500	14,100	Ditto	71,970	2310	6301	15.428"	1.72	23,004	22.09 "	1.79	30,864	23.05 "	1.82
...an.	Ditto	J. Brown and Co.	J. Brown and Co.	500	14,100	Ditto	72,003	2310	6389	15.2 "	1.75	22,927	21.96 m.m.	1.74	31,208	23.23 m. m.	1.94
...e...	Ditto	Pembroke Yard	Maudslay, Son, and Field	435	11,000	Ditto	47,300	1408	3843	12.3 "	1.83	14,100	19.8 (log)	1.66	18,649	21.0 (log)	1.55
...rd ...	Ditto	Fairfield Company	Fairfield Company	440	9,800	Ditto	50,344	1610	4522	14.9 "	1.91	16,005	21.27 "	1.97	22,457	22.7 (")	2.12
......	Ditto	Portsmouth	Hawthorn, Leslie, and Co.	440	9,800	Ditto	50,300	1610	4632*	14.7 "	1.81	16,209*	20.45 m. m.	1.83	22,249*	21.7 (")	1.89
...a ...	Twin-screw sloop	Sheerness Yard	Sheerness Yard	185	1,070	Belleville	4,020	136	331	8.8 "	1.81	1,034	13.5 (log)	1.69	1,460*	13.43 m. m.	1.64
......	Ditto	Ditto	Wallsend Slipway and Engineering Company	185	1,070	Babcock & Wilcox	4,000	136	308	9.4 "	1.52	1,026	12.0 "	1.50	1,433	13.64 "	1.53
...tome...	Ditto	Ditto	Keyham Yard	185	1,070	Niclausse	3,960	135	338	9.3 "	1.72	1,018	12.5 "	1.55	1,448	13.63 "	1.86

* Preliminay Report only.

M. M. means measured mile.

—*Engineering.*

The Minerva and Hyacinth are now being prepared for another competitive run to Gibraltar under conditions analogous to those laid down by the Navy Boiler Committee; but on this occasion the trials will be conducted by the Admiralty. They are primarily intended for the testing of new propellers, the original screws having given somewhat surprising results. The Hyacinth, although she had more engine-power than the Minerva, did not realize so great a speed. New screws have been fitted, and should yield important data. At the same time it is intended to take as complete information of the working of boilers and machinery as was made by the dockyard staff for the boiler committee and collated by the members of the committee. Neither type of boiler, it will be remembered, came out of the tests satisfactorily, for while the cylindrical boilers of the Minerva got choked at the tube ends by bird-nesting to such an extent that she could not have steamed further than Gibraltar on any pretext, the Belleville boilers of the Hyacinth burned more coal per unit of power, and the tubes leaked at the point where they are screwed into the boxes joining each pair of tubes together. Moreover, some of the figures tabulated in the boiler committee report were contradictory, and the Admiralty have come to the conclusion that a repetition of the competitive trials will be helpful in deciding the boiler question. The two cruisers, which will leave in about a week, will go to Gibraltar at three-fourths power, the object being as before to cruise at that point until all the coal in their bunkers is consumed, each having of course the same quantity to begin with. They will return at the best speed possible.—*United Service Gazette*, December 6, 1902.

The Admiralty, in making arrangements for the forthcoming trials between the cruisers Minerva and Hyacinth, are exercising great care as far as the coaling of the vessels is concerned, as it has been suggested that prior to their last run to Gibraltar the coal in both vessels was not of the same quality. The first part of the programme provides for each vessel shipping 1000 tons of coal, to be stowed in the working bunkers. They will then leave Plymouth in company, and, maintaining an indicated horsepower of 7000, will steam to Gibraltar and back without stopping until the coal is exhausted, the passage to the nearest port being made by the aid of coal from the reserve bunkers. After completing the long run at 7000 indicated horsepower for the consumption of the 1000 tons of coal, the ships are to have a full-power trial race from Gibraltar to Portsmouth. —*Engineer,* January 9, 1903.

With regard to the new steam trials of the Hyacinth and Minerva, we learn that the Hyacinth will be quite ready to start on the 20th inst., the date originally fixed; but machinery defects have been discovered in the Minerva which will make it impossible for her to be ready until the end of the month. Both vessels will make a start on the 2nd prox., and will remain in company until one can leave the other on the race home from Gibraltar. Unfortunately for the Hyacinth's chance, we learn from the *Western Morning News* that she is still handicapped by an excessive leakage of feed-water, and it seems remarkable that, although this leakage has been continuous throughout the whole trials, extending over two years, the most careful surveys have failed to disclose the cause of the mischief. —*Engineer,* January 16, 1903.

The Hyacinth and Minerva left Plymouth on Wednesday on their competitive boiler and speed trials to Gibraltar, the programme ordered to be carried out being somewhat similar to, although with one or two important differences from, the trials of a few months ago. On this occasion the tests are under the direction of Admiralty officers; the boiler committee were invited to send representatives, but they did not consider it necessary to do so. The Hyacinth has been fitted with new

propellers of increased surface since the last trials, when, notwithstanding that her engines gave greater power, the speed of the ship was less than that of her sister ship the Minerva. These propellers give about a quarter of a mile per hour more speed.

Both the Hyacinth and Minerva left England with the same quantity of coal and of feed water on board, and are to steam south at 7000 indicated horsepower, continuing as long as the coal lasts. This will determine the actual coal endurance of the ships. On the former trial neither ship went to the utmost limit, owing to the choking or bird-nesting of the tubes in the cylindrical boilers of the Minerva and to water leaking from the Belleville boilers of the Hyacinth. When their coal is exhausted they will put into Gibraltar, and they will at once prepare for the return journey. On this occasion the time required for such preparation will be an element in the contest. Each ship will hoist a signal to indicate the moment when all is ready for the return trip, and thereupon examination will be made to verify the fact. The departure on the home run will be intimated according to convenience, and both ships will leave together to get home as fast as possible. The return run will therefore be a speed contest.

It has been decided to hand over the Hermes to the boiler committee when ready about a month hence, so that they may make a series of exhaustive trials with the new boilers of this cruiser, which are of the Babcock and Wilcox type. The Hermes is a sister ship to the Hyacinth, with engines of 10,000 I. H. P.; this is the largest vessel completed with this type of boiler, so that the trials may be interesting, while the results will be comparable with those got with the Hyacinth and Minerva with Belleville and tank boilers respectively. The boiler committee have also in progress trials with the Medea and Medusa, having large tube Yarrow and Dürr boilers. This will complete the work of the committee.—*United Service Gazette*, February 7, 1903.

THE MINERVA AND THE HYACINTH.—For some days past an interesting trial of speed and endurance has been in progress between H. M. S. Hyacinth, with Belleville, and H. M. S. Minerva, with Scotch boilers. The vessels ran out to Gibraltar, went into harbor, proceeded to sea again, and ran until all coal was expended. They then re-coaled at Gibraltar as quickly as possible and proceeded to race home to Portsmouth. On the run home it is stated that the Hyacinth beat the Minerva until the bay was entered. Then the Hyacinth got hot crank pins, which were, however, kept from running the white metal in the big ends by constant lubrication and the water services. At last, however, unhappily, one of the big end bolts of the port intermediate engine broke, and the Hyacinth had to finish her voyage with her starboard engine only. According to the semi-official report which has reached us, the Minerva arrived at Spithead at two o'clock on Wednesday morning. The Hyacinth had done so well that at the end of the twenty-first hour she was leading by 45 minutes, though it is claimed for the Minerva that she was so steadily lessening the distance between them that the hope was confidently entertained that she would win in the end. The Minerva eased down to 18 knots, and passed St Catherine's in 62 hours, less two minutes, after leaving Gibraltar. She went into Portsmouth Harbor and awaits orders. The Hyacinth arrived at Plymouth on Wednesday afternoon, and went into Devonport Harbor.—*Engineer,* February 20, 1903.

The race between the cruisers Minerva and Hyacinth from Gibraltar to Portsmouth has resulted in an easy victory for the former vessel, the Hyacinth breaking down. The Minerva arrived at Spithead at 2 o'clock on Wednesday morning. The Hyacinth had done so well that at the end of the 21st hour she was leading by 45 minutes, though it is claimed for the Minerva that she was so steadily lessening the distance that the

hope was confidently entertained that she would win in the end. Unfortunately, however, at this point the crankhead bolt of the port intermediate engine of the Hyacinth broke, and though an effort was made, after the engines had been disconnected, to repair the damages at sea, the attempt had to be abandoned, and the vessel, working with her starboard engine only, gave up the race. The Minerva eased down to 18 knots, and passed St. Catherine's in 62 hours, less two minutes, after leaving Gibraltar. She went into Portsmouth Harbor on the morning's tide, and awaits orders. The Hyacinth arrived at Plymouth on Wednesday afternoon, and went into Devonport Harbor.—*United Service Gazette,* February 21, 1903.

STEAM TURBINES.

Reversing Steam Turbines.—One of the principal difficulties of adapting the steam turbines to marine use lies in the necessity of providing some arrangement for reversing the motion of the ship. In the case of oil launches a similar difficulty has had to be faced, but for the small powers and speeds here needed it has not proved difficult to construct reversing propellers, a hollow shaft being used in conjunction with pivoted blades. Such a system seems, however, hardly applicable to the transmission of the heavy thrusts involved in the case of high speeds and large vessels, and consequently some attention is now being directed by one or two large firms to the construction of reversing turbines. The difficulties in making these are purely mechanical, since from the point of view of efficiency it is indifferent whether the turbine wheel rotates in one direction whilst the casing is held fast, or whether the latter is allowed to revolve in the opposite direction and the turbine proper held fast. The relative motion of the steam through the guide-blades and buckets is identically the same in the two cases, though in the second case the steam should be introduced into the casing with an angular velocity equal to that of the casing, and a corresponding arrangement should be made at the exhaust end. By coupling up through friction clutches either the casing or the turbine wheel to the propeller shafting, the latter could be driven in either direction at will. We are unacquainted with the principles on which the firms above referred to are at present experimenting, but the governing ideas are probably somewhat on the above lines. The mechanical difficulties are doubtless considerable, but if they are conquered, the reciprocating marine engine will certainly be in danger of being relegated to the scrap heap. As matters stand, many of the commanders of the great ocean liners are decidedly averse to any change in the propelling machinery which will put it out of their power to go full speed astern. This power, it is true, resembles the Westerner's revolver, in that it is seldom needed, but when it is required it is wanted "mighty bad."—*Engineering,* December 19, 1902.

The steam turbine seems to make steady progress. The units for the Lot's-road Generating Station at Chelsea will be of 8000 horsepower capacity. They are to be built partly in Pittsburg, but will be finished at the works of the British Westinghouse Company, at Trafford Park, Manchester. Mr. Yerkes has stated that the Lot's-road Station, though of much greater capacity than the Glasgow Tramway generating station, will only cost two-thirds as much, and part of the saving is, without doubt, due to the adoption of the steam turbine. Turbo-generators of 4000 horsepower are being supplied to the Milan-Ceresio Railway by Messrs. Brown-Boveri and Co. All these large units appear, however, to have been supplied on foreign account, since the Lot's-road Station is due to American enterprise. British engineers generally seem to have

been remarkably timid in introducing this type of generator on a large scale. Apparently the maxim still holds that a prophet or inventor is not without honor, save in his own country. We note, nevertheless, that this hesitation is gradually disappearing, the Bristol Corporation having decided to lay down two of Parsons' turbo-generators, each of 750 kilowatts capacity; whilst the Portsmouth Corporation is ordering two of 500-kilowatt capacity. In regard to the matter of steam economy, however, it would seem that the builders of reciprocating engines do not mean to abandon the contest with the steam turbine without a struggle. So far as authentic records go, we believe the turbine has now the best of it; but we observe that Messrs. Easton and Co., in the case of some pumping engines they are building for the Antwerp Water Works Company, are guaranteeing a steam consumption of not more than 10 lb. per indicated horsepower per hour at maximum and mean load, and not more than 12 lb. at one-third of mean load. These engines will be designed to work with superheated steam on the Schmidt system. If this guarantee is met we imagine it will about beat the record; but it should be stated that the turbine builders claim that the saving in oil alone with their system is equivalent in money value to the saving of an additional 1 lb. or 1½ lb. of steam per indicated horsepower per hour.—*Engineering*, December 5, 1902.

MARINE STEAM TURBINES.—Marine propulsion by means of the Parsons steam turbine is making progress in other countries than Great Britain. A French company has been formed to exploit the marine rights in France, and the French Minister of Marine has, simultaneously with the formation of this company, signed a contract with the firm of Augustin Normand and Co., of Havre, for the construction of a first-class torpedo-boat, No. 293, to be fitted with turbo-motors on the Parsons system. This vessel will resemble in general design and fittings the usual type of this class of boats in the French service, and will have a displacement of about 90 tons. The turbine installation will consist of three motors in series, driving three shafts with multiple propellers. She will also be supplied with an auxiliary cruising turbine, to be utilized for economical working at the low powers demanded for ordinary cruising speed. The boilers will be of the usual Normand type, and the power and speed are not designed to exceed those of other boats of the same class. This order is to be completed in the course of next year. The torpedo-boat No. 243, fitted with Rateau turbines, which should have been delivered in 1899, has not yet passed its speed trials, and is still in the contractors' hands. Further orders have been received for vessels supplied with Parsons turbines on the Continent, and there is reason to anticipate that marine propulsion will follow closely the development which has taken place on the Continent in turbines on the Parsons system for electrical work. Over 16,000 horsepower have been installed within the last year for electrical purposes on the Continent, and the orders received by the continental firms exceed 30,000 horsepower.—*Engineer*, December 12, 1902.

The torpedo-boat destroyer Eden, building by Hawthorn, Leslie and Co., for the Admiralty, to the order of the Parsons Steam Turbine Company, is to be propelled by steam turbine engines, the machinery being similar to that fitted in the Viper and Velox, but driving three, instead of four shafts, with two propellers on each side, or six propellers in all.

In the field of steam engineering, the most notable progress during 1902 has been in the development of the steam turbine; indeed, it is safe to say that this form of motor is destined to work the most radical innovation that has been seen in steam engineering since the introduction of high-pressure steam and multiple-expansion engines. Every year in the

history of the turbine serves to demonstrate more fully its good qualities, and to justify the faith of its inventor in its ultimate substitution for the reciprocating engine in the majority of the uses to which the latter is now put. In the present stage of its development, its advantages may be summarized as follows: On small units doing continuous service in a power station, it has shown a steam consumption of under 13¾ pounds per indicated horsepower per hour; while in a larger unit it has shown as low as 10.17 pounds per indicated horsepower per hour. It has been found that in plants already built, or now under construction, the steam turbine requires only about 80 per cent as much space as is necessary for a vertical engine of the same power, and only 40 per cent of that needed for a horizontal engine. In one case the volume of masonry foundation required for a turbine was found to be only one-ninth as great as that for a vertical, and one-fifteenth as great as that for a horizontal engine, while the cost of the building to house the same was only about one-half that of the horizontal or vertical. The turbine plants that have been in operation during the past few years have shown high economy and call for practically no repairs. In marine work the turbine has repeated, in the new river passenger steamer Queen Alexandra, the good results shown in the King Edward. On her trial trip this vessel made 21.63 knots an hour. Compared with passenger steamers of similar size, but having reciprocating engines, the installation of turbines has shown a gain per indicated horsepower in favor of the turbine steamer of 20 per cent. Its compactness and absence of vibration have led to its introduction on steam yachts; one, the Resolution, has been built and is running in this country, and three others have been built in Great Britain. In a paper recently read before the British Association, Mr. Parsons stated that the adoption of the steam turbine for large battleships, cruisers, and trans-Atlantic liners will be attended with greater proportional advantages even than those shown in smaller vessels. Outside of the steam turbine there has been no radical change to record in steam engineering during the past year. Steam pressures for water-tube boilers remain at from 250 to 300 pounds per square inch, and for Scotch and locomotive boilers, at about 200 to 225 pounds.—*Scientific American.*

The steam turbine has lately been used in the reversed direction for compressing air, an ordinary steam turbine being coupled direct to the air turbine. This air turbine is very similar to the steam turbine, and consists, as usual, of alternate rows of moving blades and guide blades, and is driven at a high speed, each row of blades increasing the pressure, and giving a steady blast.—*Engineer.*

WIRELESS TELEGRAPHY.

The Present State of Wireless Telegraphy.—It is now eighteen months since we last attempted in these columns to take a general survey of the development of wireless telegraphy. In the history of a science which has enlisted the service of so many skilled experimentalists, each of whom has made rapid progress along his own lines, eighteen months is a comparatively long period; as a result, we are compelled to-day to regard the subject from a very different point of view. At that time, there were practically only two systems—Mr. Marconi's and Prof. Slaby's —which had advanced to such a degree of perfection that they deserved special consideration. To-day, it would hardly be too much to say that in every civilized nation there are one or more inventors with a carefully worked-out and tested system ready for general use. Particulars of these different systems have been published from time to time and have been

duly referred to in *Nature;* unfortunately, the information published is not, as a rule, of the kind that one most desires to obtain; too often it is obviously "inspired," and consists for the most part of insufficiently supported claims to successful syntonization, or to record making in the way of long-distance transmission or rapid signaling, information which is very acceptable to the daily papers, which forget one day what they have published the day before, but of little use to those who are seriously interested in the subject.

So far as can be judged, the various systems differ chiefly in matters of detail, the design of circuits and the special construction and arrangement of apparatus; improvements depending on the introduction of a principle fundamentally new are few and far between. We do not wish to underrate the value of these detailed improvements; they are, as we well know, often the talismans converting failure into success, but their interest is mainly for the specialist. It is not our intention, therefore, to enter into a detailed examination of the different systems; to do so would only involve us in a mass of technicalities from which the reader would probably "come out by that same door where in he went." Those who wish for this information must be referred to the technical press or to the files in the Patent Office, where they will probably find, as for example, in the two hundred odd claims in Mr. Fessenden's patents, all the particulars they desire. We propose rather to treat the subject on a broader basis, and to endeavor to form an estimate of how far wireless telegraphy in its present state has fulfilled the expectations that have been raised in the past or justifies hopes that may now be entertained for a future of wide utility.

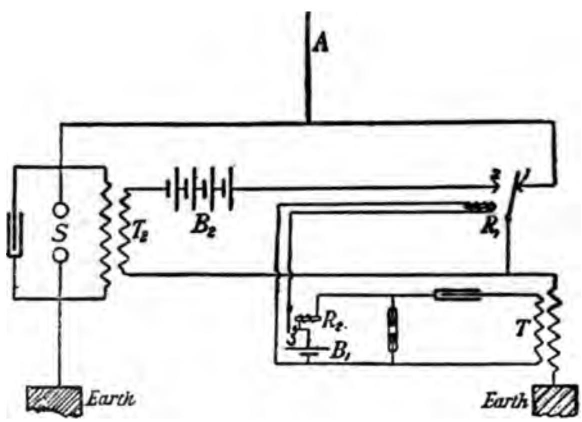


FIG. 1.—DIAGRAM OF CIRCUITS IN GUARINI'S REPEATER.

The first question that one feels inclined to ask is, At what end are all these inventors aiming? Is it to devise a system of wireless telegraphy to compete with ordinary telegraphic methods, or is it for what seems to us the more useful purpose of creating a means of communication where none now exists, especially between ship and ship and ship and shore? It would seem that in some instances, as, for example, that of the Marconi Company, the former purpose is almost as much in view as the latter. In the former case, there can be no question but that absolute syntonization is necessary; in the latter, it is less important and even in some respects undesirable, but, on the other hand, it is essential that the differ-

ent systems should work together so that any ship should be able to signal to any station. It would be a great misfortune if this principle is lost sight of in the rivalry between competing methods and if we thereby lose what seems to be in reality the greatest benefit wireless telegraphy can confer, the increase of the safety and convénience of traveling by sea. This is, we think, the most urgent problem that wireless telegraphy presents to-day, and we trust that it will find a really satisfactory solution at the coming Berlin Conference.

The attempts which have been made at syntonization are, indeed, far from encouraging. It is true that almost every inventor claims that he has solved the problem, but all the experiments that have been quoted are open to criticism. It is important to recognize what a successful solution really means; it is not sufficient to demonstrate, as has been done many times, that two messages can be transmitted or received at the same time by the same installation without interference; that, in short, duplexing is possible. This is a great step, no doubt, but to solve the problem it is necessary that the tuned transmitter shall affect no other

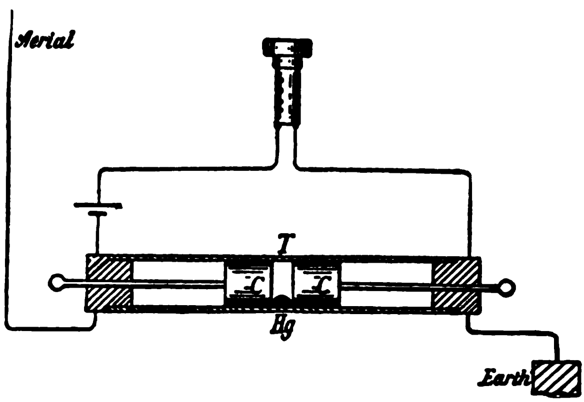


FIG. 2.—CASTELLI COHERER AND CONNECTIONS.

receivers than those syntonized with it, and that the tuned receiver shall respond only to the proper waves; this, it will be seen, is a requirement much harder to satisfy. As an example, showing how far existing practice is from satisfying these conditions, we may quote the case of the recent long-distance work done by the Marconi Company. Mr. Marconi, it will be remembered, has several times claimed to have solved the problem of syntonization, and, confident of having done so, issued a challenge last February to Sir W. Preece or Sir O. Lodge to intercept any of his messages, offering to put a station, in the neighborhood of his Poldhu station at their service. This challenge has been answered in a conclusive manner during the past month by Mr. Nevil Maskelyne, who showed that the installation which he was working at Portcurnow had been receiving the messages sent to the Carlo Alberto on her recent cruise from England to Italy (see the *Electrician*, vol. L, pp. 22 and 105). It is clear, therefore, that with no special preparation on either side, it is possible to tap the signals that are being sent by the Marconi Company over long distances, and in face of this the claims to a real solution of the syntonization problem fall to the ground. We doubt whether any other system would stand the same test.

But if on this side the outlook is somewhat dispiriting, in other directions matters are more encouraging. This year has witnessed the remarkable achievements by the Marconi Company in long-distance work. It has been shown that it is possible to signal across the Atlantic, a distance of more than 2000 miles over water; and in the cruise of the Carlo Alberto signals were transmitted a distance of 750 miles over land and water. To cover these great distances, the power used at the transmitting station has to be correspondingly great; in consequence, the signaling was only from Poldhu to the ship and not in the reverse direction. The importance of these experiments, however, lies rather in the conclusive demonstration of the fact that it is only a question of providing sufficient power to signal over any distance, however great, and therefore no fears need be entertained of the utility of the wireless telegraph being limited by considerations of distance. No other experimenter has attained such success in long-distance work as Mr. Marconi, but no other experimenter has used such large power for transmission. Unfortunately, sufficient particulars are not available to enable a comparison to be made between the distances attained with different systems using the same amount of power; this is a point on which the publication of trustworthy data would be of the highest value. An interesting phenomenon brought out by Mr. Marconi's long-distance work is the effect produced by daylight on transmission. It is found that the signals carry much further during the night (i. e., night at the transmitting station), the result being due, it is suggested, to the discharging effect of sunlight on the aerial wire (see *Nature*, vol. LXVI, p. 385).

With reference to long-distance work, the interesting experiments of M. Guarini with an automatic repeater may be quoted. This inventor designed an apparatus which would pick up a message, received from one station, *A*, and pass it on to a second station, *B*, which was out of the range of the signals transmitted direct from *A*. The principle of this apparatus will be understood from the accompanying diagram (Fig. 1) in which, for the sake of clearness, only the essential circuits are shown. The aerial wire, *A*, at the repeating station is connected through the contact, I, of the relay, R_1, and through the primary of a transformer, *T*, to earth; it is also connected through the spark gap, *S*, to earth. The coherer is connected in series with the secondary of *T* and a condenser. When a signal is received, the resistance of the coherer is broken down, and the battery, B_1, sends a current through it and the relay, R_2, thus closing at the contact 3 the circuit of the relay, R_1. The contact arm of R_1 swings over to 2, thus disconnecting the aerial from the receiving circuit and closing the primary of the induction coil, T_2, thereby causing a spark to pass across the gap, which means that the signal is sent out again from the aerial, *A*. The coherer being tapped back, the various circuits are opened, and the arm of R_1 returns to its original position and so is ready to receive the next signal. Experiments were carried out between Antwerp and Brussels (42 km.), the repeating station being at Malines, about half-way between the two; the results were promising, though the repeater did not prove absolutely trustworthy.

We may now turn from the consideration of the results achieved to the apparatus that has been used. In the transmitting apparatus, attention has been chiefly devoted to devising means of generating oscillations of definite wave-length. None of these call for special comment. In some cases, for obtaining the spark, alternating-current generators have been employed in connection with step-up transformers instead of induction coils. This is the case in the De Forest system, which, it may be remarked, claims the record for speed of forty-eight words per minute; the alternator generates, at 500 volts, 60 cycles, and this is stepped up to 25,000 volts for sparking; the signals are formed by interrupting the primary circuit of the transformer by means of a specially-designed key.

The difficulty of breaking a large current in this way is considerable and has obviously proved a stumbling-block to the Marconi Company, as it forms the subject-matter of two or three patents taken out by Prof. Fleming and the company. Some of the methods described therein are exceedingly ingenious, but, unfortunately, space does not allow us to describe them here, especially as their bearing on wireless telegraphy is only indirect.

With the exception of the magnetic detector devised by Mr. Marconi and tested during the cruise of the Carlo Alberto, practically all the different systems make use of the coherer principle for receiving. The actual type of coherer used differs considerably in the several cases. For long-distance work, it has generally been found most suitable to use a coherer which requires no tapping back, but spontaneously returns to its normal condition, this being connected in parallel with a telephone. One of the chief advantages of this arrangement lies in the fact that the energy required to give audible signals in the telephone is much less than that needed to work a relay. There are several different coherers working

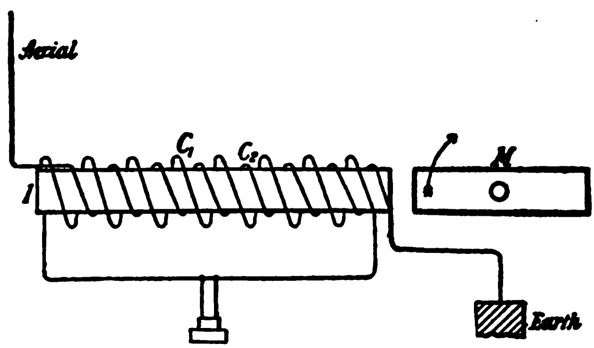


FIG. 3.—DIAGRAM OF MARCONI'S DETECTOR.

on this principle—the principle really of the microphone; in the system devised by M. Popoff, carbon granules form the loose contacts, the resistance, which is normally high, being broken down by the received waves and the coherer then restoring itself to its original condition; the change in the current through the coherer causes a click in the telephone. In the De Forest system, an electrolytic "anticoherer" is used; this has a paste, composed of a viscous material, loose, conducting particles and an electrolyte between suitable electrodes. In the normal condition, the conducing particles bridge the gap and give the receiver a low resistance; electrolysis is set up by the received oscillations and the consequent polarization greatly increases the resistance. Of the coherers of this type, the greatest interest attaches to the Castelli coherer. This, invented by a semaphorist in the Italian navy, was used by Mr. Marconi in his first transatlantic experiments. Its construction is shown in Fig. 2. Two iron or carbon electrodes, *C C*, fit into the tube *T*, and are connected by a single drop of mercury, *Hg*. The connections shown are, of course, the same in the case of the two other coherers just described. When electrical oscillations reach the tube, the mercury coheres to the electrodes, but returns at once to its normal condition when the stimulus ceases. The magnetic detector to which we have made reference above was described by Mr. Marconi in a paper read before the Royal Society last June. Fig. 3 shows the principle of its construction. It consists of

a core of thin iron wires, I, over which are wound two coils of fine copper wire, C_1 and C_2. The outer core, C_1, is connected to a telephone receiver and the inner, C_2, to the aerial and earth or to the secondary of a transformer the primary of which is connected to the aerial and earth. The iron core is magnetized by a permanent magnet, M, at one end, which is rotated by clockwork so as to produce a continual slow change in the magnetization which, however, owing to the hysteresis, lags behind the magnetizing force. When oscillatory currents pass through the inner coil, there is a sudden decrease in the hysteresis, due apparently to the molecules being released from restraint; a corresponding sudden variation in the magnetization of the iron results, and this induces a current in the outer winding connected to the telephone.

Such, in brief, are the more important advances that have been made in the practice of wireless telegraphy during the past year. In addition, much work has been done on the purely scientific side of the subject, the action of the coherer in particular having been submitted to somewhat rigorous examination, work which has already produced results which may prove both of great physical and great practical value. It may fairly be said that we know now, with a considerable degree of certainty, some of the more useful services which wireless telegraphy may be relied upon to perform. Already its commercial application is considerable; many ships, in the navies of this and other countries and in the merchant services, are equipped with wireless telegraphic apparatus which has, we believe, fully justified its installation. It is in this direction that we look with the most confidence for a steady increase in its application, and we would rather hear of a few more ships being thus equipped than of another "S" being transmitted across the Atlantic.—Maurice Solomon in *Nature.*

MISCELLANEOUS.

At Portsmouth on Thursday last week the Majestic, flagship of Vice-Admiral Sir A. K. Wilson, Commander-in-Chief of the Channel Squadron, took in 1700 tons of coal at the average rate of 212.5 tons per hour. In one hour she took in 257 tons, the largest quantity ever placed aboard a warship in that length of time. The coaling evolution was carried out under the supposition that the ship had returned to harbor with her machinery in a disabled condition. None of her own appliances were used, as they were supposed to be unavailable owing to the breakdown of the engines. All the coal was lifted aboard by the apparatus fitted to the barges, although the work of filling and stowing was done by the Majestic's crew. Alongside the coaling point two years ago the Majestic took in 204 tons per hour, but the Mars on that occasion beat her by shipping coal at the hourly average of 204.5 tons.—*United Service Gazette,* January 31, 1903.

The coaling returns of the four battleships forming the Portsmouth division of the Channel Squadron show some interesting and surprising results. The Mars and Hannibal, for instance, filled their bunkers alongside the dockyard coaling station under conditions which were as nearly as possible identical; but while the Mars took in 1570 tons at the rate of 241 tons an hour, the Hannibal shipped 1645 at the hourly rate of 135 tons. Exactly the same rate of shipment was maintained in the Prince George, which stocked her bunkers with 1670 tons in 12½ working hours. She was coaled from lighters on both sides while berthed at the south railway jetty, and had not therefore the same facilities as are afforded at the coaling station. The Majestic coaled in the harbor stream from a floating coal depot on one side and lighters on the other, and every effort

was made to beat the best record of the Mars, which at that date was 208 tons an hour. The flagship accomplished her purpose, having taken in 1770 tons at the rate of 221 tons an hour, but a fortnight later the Mars once more asserted her supremacy with an hourly rate of 241 tons.—*United Service Gazette*, February 21, 1903.

HAMBURG FLOATING DRY-DOCK.—In January of last year the Reiherstieg Schiffswerfte und Maschinenfabrik, Hamburg, entrusted to the Flensburger Schiffsbau Gesellschaft, Flensburg, Germany, the building of a large "offshore" floating dock, to the designs of Messrs. Clark and Standfield, of Westminster. The first plate was laid on the keel blocks on the 15th of March, and by the launch of the second half on the 1st of October the dock was practically completed. It consists of two equal sections securely bolted together, having a total length of 507 feet 9½ inches. The breadth is 100 feet ½ inch, and the height 41 feet ½ inch. With these dimensions a vessel of 11,000 tons dead weight can be lifted; the proposed time for doing this is estimated at about 1½ hours.

The outfit is very complete, comprising all the latest designed improvements for efficient and rapid docking. Besides mechanical bilge and side shores, there are two hydraulic side shores for centering the vessel on the keel blocks. The dock is provided with eight engines, directly coupled by means of rods to an 18-inch centrifugal pumping installation consisting of eight Gwynne pumps. From the main drain, also 18 inches in diameter, there are 32 branches leading to all compartments. Each valve of the pumping compartments is fitted with its own hydraulic press, but certain presses are grouped together and worked by a single lever in the valve house, which is situated on top of the wall. Hydraulic pressure is generated by two accumulators placed upon the respective halves of the dock, whilst steam for the engines is obtained from the shore.

A Worthington pump provides a washing-down service for washing down vessels, as well as filling up their tanks, and a steam service is fitted throughout to protect the inlet and outlet pipes, valves, bilge shores, etc., against frost, and also for heating purposes.—*Marine Engineering*, February, 1903.

A NEW DEPARTURE IN SHIP LOGS.—Mariners have long been looking for a ship log or speed-recording instrument which can be sufficiently relied upon to determine accurately a vessel's location in foggy or stormy weather, when observations cannot be obtained. The usual method of towing a heavy float or propelling wheel on a line many feet in length involves many difficulties. Whenever the ship stops the line must be immediately attended to, lest it, with its attachments, be lost; and every time the vessel starts, the log must be cast overboard, and care taken that the line does not foul the wheel. The log is also liable to injury from driftwood, and heavy seas interfere with its accuracy. A radical departure from the towing type of log has been introduced by the Nicholson Ship Log Company, of Cleveland, Ohio. The new log comprises, essentially, two tubes which project through the bottom of the vessel and extend vertically to an indicator mechanism located in the pilot house or any other convenient location. One of these pipes, which is shown on the left in our diagram, is open at the bottom and, therefore, permits water to flow in to a height equal to the draft of the vessel; while in the other pipe, since the bottom is closed and the opening is in the side of the projecting portion, the water will rise above the load-water line to a height proportional to the pressure caused by the speed of the vessel. Each tube is provided with a float. The float in the "speed-tube" is arranged to communicate its variations of level through suitable gearing to a vertical feed shaft. The upper end of this shaft is threaded, and at each end of this threaded portion a disk is mounted. These disks are connected by

rods, which pass through a nut or hub threaded on to the shaft. It is evident that any change of water level in the speed-pipe will cause the feed shaft to rotate, thus raising or lowering the hub, which is kept from turning by the rods above mentioned. In order to compensate for changes in level due to variations in the load of the vessel, connection is made between the float in the "level-pipe" and the disks mounted on the

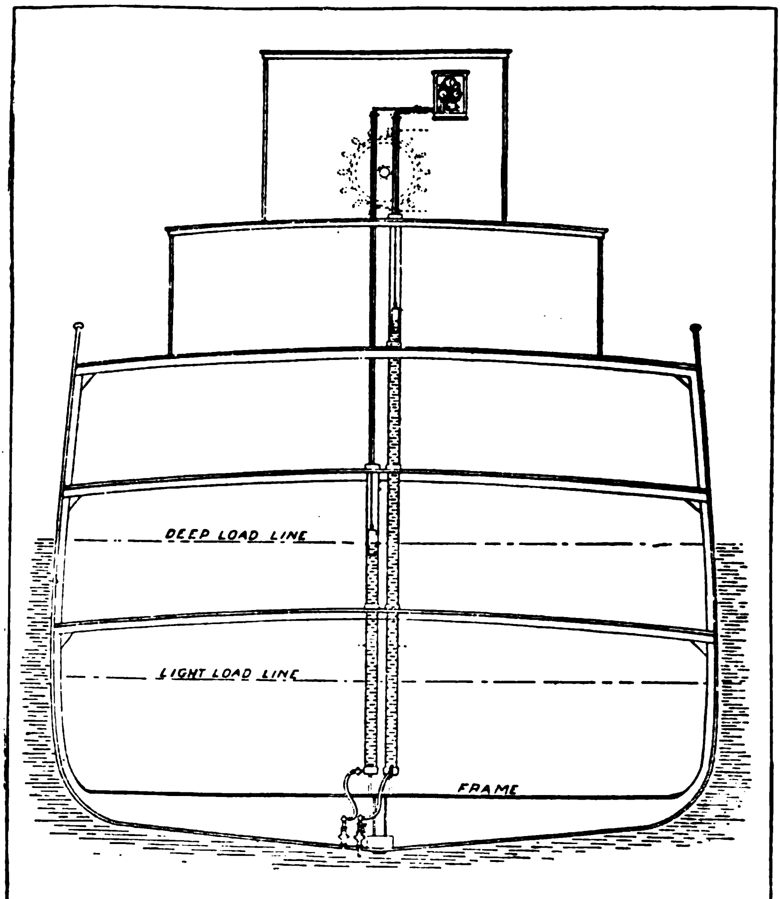
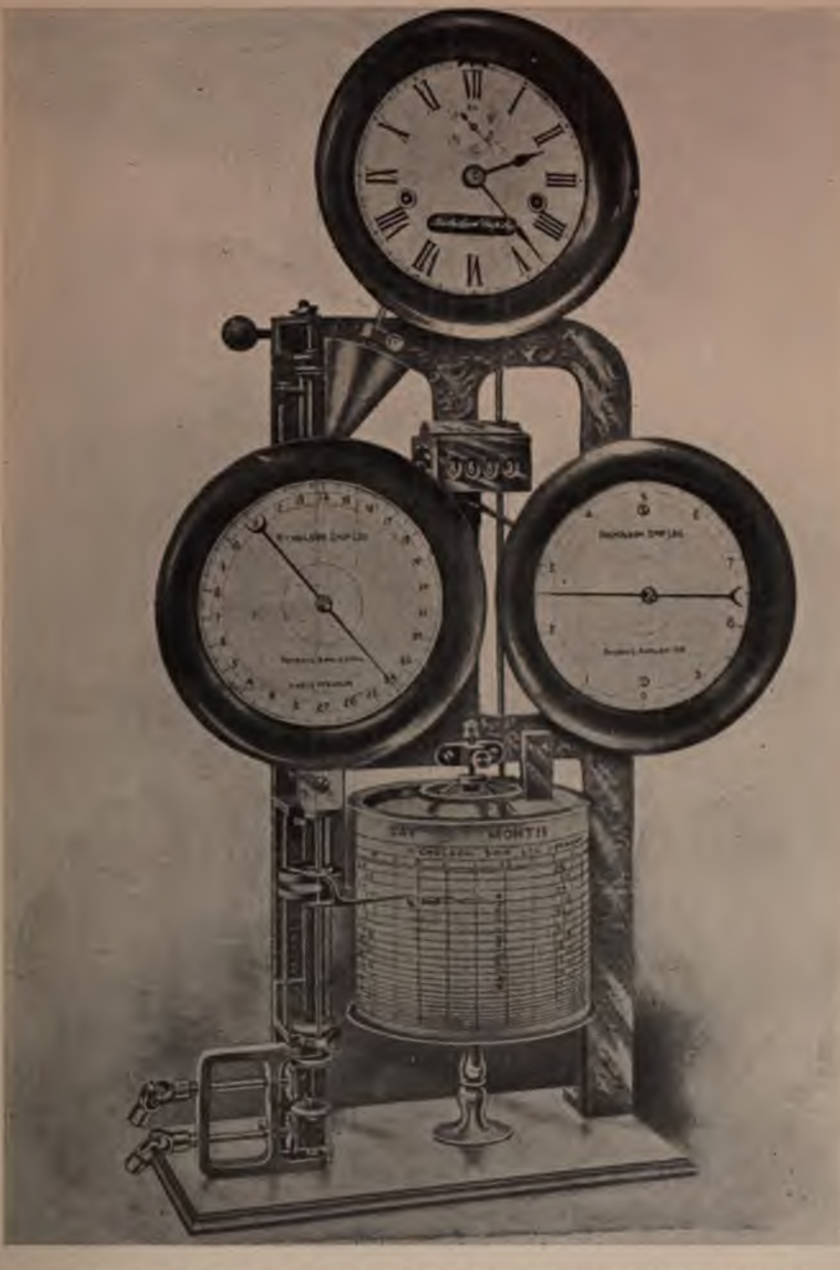


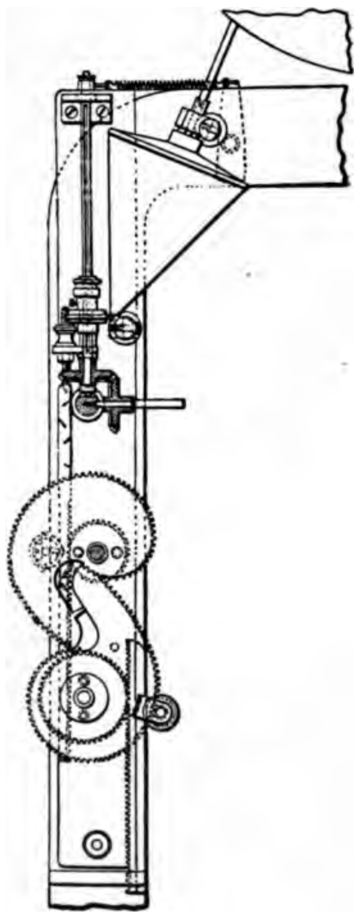
DIAGRAM SHOWING LOG INSTALLED IN A VESSEL.

feed-shaft, so that a rise or fall of this float will result in a compensating rotation of the disks and the rods which connect them. Thus the hub is rotated and fed up or down the feed-shaft according to the load of the vessel. The adjustment is such that when the vessel is at rest the hub will always remain at its lowest position, no matter what the level of water in the level-pipe. Suitably connected with the hub is a rack, which rises and falls with the same. This rack governs the motions of the pointer



IMPROVED SHIP LOG COMPRISING A SPEED INDICATOR, A DISTANCE RECORDER, AND A SPEED CHART.

in the speed-indicator. It has been found that the water level in the speed-pipe varies approximately as the square of the speed, and therefore, it would obviously be confusing to have the rack operate directly on the pointer. A train of intermediate gearing is therefore used, as shown in our detailed view. This train includes a pair of compensating gear wheels, which are so designed that the upper member of the pair will move



THE SPEED GEARS AND DISTANCE-RECORDING MECHANISM.

through the same arc for every corresponding increase of speed of the vessel. Thus a perfect record of speed is at all times indicated on the dial.

In addition to the speed-indicating mechanism is a speed-recording mechanism, which comprises a chart drum rotated at a uniform speed by clockwork. A pencil or marker is arranged to slide up and down with the speed-indicator hub, and all the variations of speed are recorded on the chart.

The distance-recording mechanism, as shown in our detail view, comprises a friction wheel, which is splined to a vertical shaft and rotated by engagement with the face of an inverted cone driven at a uniform rate by the clockwork at the top of the ship log. This motion serves to operate a small counter through the medium of a pair of miter gears. Since the distance covered by the vessel is equal to the time multiplied by the speed, a rack and gear connection is provided between the speed-indicator shaft and the friction wheel, whereby the latter is moved upward along the face of the cone as the speed increases. This causes the friction wheel to rotate more rapidly, so that the miles are counted off with a proportionately higher speed on the distance recorder. To the right of the counter is a dial which indicates fractions of a mile or knot, as desired.

A trial of the Nicholson ship log was recently made by the United States Navy, the torpedo-boat Porter being equipped with this apparatus. The results of the trial were very favorable. The desirable features reported are briefly as follows: The actual speed of the vessel is shown on the speed dial at all times. Its accuracy is not affected by the conditions of the sea. It will not foul readily, though, in case of fouling, provision is made for clearing it by withdrawal of the tube. No towing line is required. The only portion of the log outside the hull of the vessel is a one-inch pipe sufficiently long to clear the eddy set up by the skin friction. The only attention required is the daily winding of the clockwork. The undesirable features mentioned are as follows: The height of float-pipe required is objectionable, particularly for vessels of low free-board, such as the Porter, on which it was necessary to rig a 3-inch pipe 20 feet or more above the deck. The size of the recording mechanism (31 x 19 x 9 inches) is large compared with that of logs in general use. The speed and recording dials should be graduated in tenths of knots, and the chronograph should be omitted. In regard to the first of these objections, the builders inform us that this has been entirely overcome, and pipes can be stored away between decks on the fastest vessels of low free-broad type without reduction of delicacy in registration. Obviously the second objection is far outweighed by the advantages offered by the log, and the third undesirable feature is merely a matter of detail, which can be easily remedied to suit requirements. In summing up these features, the Navy Bureau of Equipment consider that the inlet pipes are liable to become fouled when navigating in shoal water, where mud and sand may be stirred up. However, no such complaints have been received from users of the log. The Nicholson ship log has been installed on a number of the Lake steamers, and has given perfect satisfaction.—*Scientific American*. March 7, 1903.

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Lieutenant W. H. G. BULLARD, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Professor PHILIP R. ALGER, U. S. Navy.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U.S.N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U.S.N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U.S.N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U.S.N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U.S.N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U.S.N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U.S.N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U.S.N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U.S.N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U.S.N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U.S.N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U.S.N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U.S.N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U.S.N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U.S.N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U.S.N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORT FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U.S.N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins, U.S.N.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U.S.N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U.S.N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U.S.N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U.S.N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U.S.N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U.S.N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U.S.N.

SUGGESTION FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U.S.N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U.S.N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U.S.N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U.S.N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U.S.N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U.S.N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U.S.N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U.S.N.I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U.S.N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U.S.N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U.S.N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U.S.N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U.S.N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U.S.N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U.S.N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U.S.N.

A Naval Training Policy and System. Honorable Mention, 1903. By Lieutenant James H. Reid, U.S.N.

Systematic Training of the Enlisted Personnel of the Navy. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U.S.N.

Our Torpedo-Boat Flotilla. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U.S.N.

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE.

To The Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1902.

Itemized Cash Account.

Receipts During the Year 1902.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Dues	$270 00	$239 25	$1067 75	$994 50	$2571 50
Subscriptions	249 84	283 36	170 48	161 28	864 96
Sale of proceedings	36 92	126 46	78 18	102 78	344 34
" " extra publications	521 28	792 71	139 23	4520 14	5973 36
Advertisements	84 25	365 90	207 50	348 75	1006 40
Interest	36 50	168 11	45 50	....	250 11
Binding	4 80	7 60	19 50	14 00	45 90
Postage	50	78	....	1 30	2 58
Life members fee	30 00	30 00	....	60 00	120 00
Expressage	....	90	....	....	90
Premium on money order	....	05	....	01	06
Credits	....	....	....	3 91	3 91
Totals	$1234 09	$2015 12	$1728 14	$6206 67	$11,184 02

EXPENDITURES DURING THE YEAR 1902.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing and binding proceedings..............	$551 98	$628 98	$688 94	$1414 81	$3274 16
Printing and binding extra publications...........	570 99	740 81	....	2793 66	4105 46
Salaries.................	345 00	345 00	345 00	420 00	1455 00
Expense of drill books...	....	....	10 00	416 00	426 00
Postage.................	51 98	76 45	86 61	91 64	306 68
Expressage..............	5 52	4 70	8 02	15 77	34 01
Cost of articles published.	119 00	55 00	199 00	102 00	475 00
Purchase of text-books...	3 02	....	6 85	....	9 87
Freight and hauling......	5 12	4 47	14 25	8 26	32 10
Discount on checks.......	95	90	2 00	1 61	5 46
Stationery..............	58 65	29 81	4 50	80 42	173 38
Office expense...........	4 00	6 10	22 10	32 89	65 09
Furniture...............	24 55	25 91	95	76	52 17
Telegrams..........	1 35	1 00	75	1 85	4 95
Brassey's annual.........	....	4 00	....	....	4 00
Check returned for endorsement..................	....	6 00	....	....	6 00
Purchase of back Nos. proceedings...............	....	6 50	....	....	6 50
Clerk's business trip to Baltimore.............	....	2 00	....	3 30	5 30
Commission to Advertising Agent......	....	50 00	50 00	....	100 00
Check voted clerk by Board of Control.............	....	....	50 00	....	50 00
Safe for office............	....	....	68 50	....	68 50
Secretary and Treasurer's trip to Baltimore.......	....	....	2 00	....	2 00
Rent of safe deposit box..	....	....	5 00	....	5 00
Insurance...............	....	....	20 50	....	20 50
Sub. Navy and Marine Corps Directory........	....	....	....	5 00	5 00
Rebate..................	....	....	....	3 25	3 25
Totals................	$1742 06	$1982 63	$1579 97	$5390 72	$10,695 38

SUMMARY.

Balance of cash unexpended January 1, 1902, including $389.14 held to credit of Reserve Fund	$ 5,241 51
Total receipts for 1902	11,184 02
Total available cash, 1902	$16,425 53
Total expenditures, 1902	10,695 38
Cash unexpended January 1, 1903	$ 5,730 15
Held to credit of reserve fund	509 14
True balance January 1, 1903	$ 5,221 01
Bills receivable for dues 1902	733 62
" " " back dues	566 65
" " " binding	21 80
" " " subscriptions	95 88
" " " sales	3,441 41
" " " advertisements	353 00
Value of back numbers, estimated	1,050 00
" " Institute property	300 00
" " extra publications	2,893 27
	$14,676 64
Liabilities for publications other than PROCEEDINGS	1,967 94
Total assets exclusive of reserve fund	$12,708 70

RESERVE FUND.

United States 4 per cent consols, registered	$ 900 00
District of Columbia 3.65 per cent registered	2,000 00
" " coupon bonds	650 00
	$ 3,550 00
Cash in bank uninvested	509 14
Total	$ 4,059 14

Very respectfully,

E. L. BEACH, *Lieutenant, U. S. Navy,*
Secretary and Treasurer.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1904.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1904. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is of sufficient merit to be awarded the prize it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either type-written or copied in a clear and legible hand.

9. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

PHILIP R. ALGER,

Professor, U. S. N., Secretary and Treasurer.

DRY DOCKS.

	No. 1.	No. 2.
Length on Top	610 Ft.	827 Ft.
Width on Top	130 "	162 "
Width on Bottom	50 "	80 "
Draught of Water over Sill	25 "	30 "

DESCRIPTION OF WORKS.

Ship Yard contains	120 Acres.
Buildings cover	10 "
Frontage on the Water . . .	2,600 Ft.
Outfitting Basin	900x500 "

PIERS.

No. 1 .	60x900 Ft.	No. 4 .	80x550 Ft.
" 2 .	60x850 "	" 5 .	60x750 "
" 3 .	191x800 "	" 6 .	60x500 "

BUILDINGS.

Machine Shop, Brick	100x500 Ft.
Boiler Shop, " . . .	100x300 "
Blacksmith Shop, "	100x300 "
Ship Shed, " . . .	60x320 "
Joiner Shop, "	60x300 "
Framing Shed, " . . .	270x344 "
Shears, ...	100 Tons Capacity.
Revolving Derrick, .	150 " "

Shops are equipped with modern machinery capable of doing the largest work required in ship construction. Tools driven by electricity and compressed air largely used in building and repairing vessels.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-eighth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

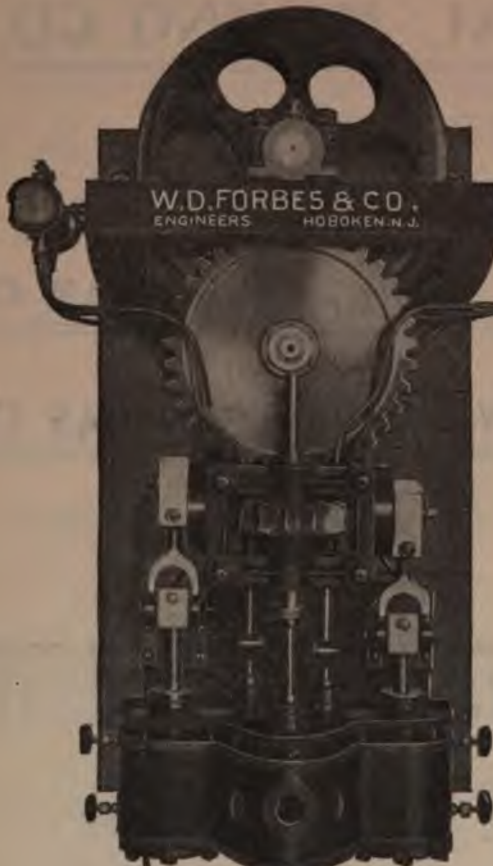
Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.



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The Naval Institute has appointed MR. GEO. L. KNOWLTON to be its Advertising Manager.

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